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013300	Submittal Procedures	12
014800	Construction Survey Staking	3
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015639	Temporary Tree and Plant Protection	6
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VOLUME 2 of 3

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT PROJECT JOB NUMBER 56-01-71

DIVISION 2-EXISTING CONDITIONS

024118	Cutting and Patching	3
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DIVISION 3-CONCRETE

033000	Cast-In-Place Concrete	20
033543	Polished Concrete Finishing	8

DIVISION 4-MASONRY

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047200	Cast Stone Masonry	6

DIVISION 5-METALS

051200	Structural Steel Framing	10
053100	Steel Decking	5
054000	Cold-Formed Metal Framing	8
055000	Metal Fabrications	9
057300	Decorative Metal Railings	7

DIVISION 6-WOOD, PLASTICS, AND COMPOSITES

061000	Rough Carpentry	9
061200	Structural Insulated Panels	5
061600	Sheathing	6
061800	Glued-Laminated Construction	6
062013	Exterior Finish Carpentry	6
062023	Interior Finish Carpentry	7
064113	Wood-Veneer-Faced Architectural Cabinets	5
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DIVISION 7-THERMAL AND MOISTURE PROTECTION

071113	Bituminous Dampproofing	3
071900	Water Repellents	4
072100	Thermal Insulation	8
072500	Weather Barriers	11
072610	Under-Slab Vapor Barrier	2
074113	Standing-Seam Metal Roof Panels	10
074213	Metal Plate Wall Panels	7
074646	Fiber-Cement Siding	7
076200	Sheet Metal Flashing and Trim	12
079200	Joint Sealants	7
079219	Acoustical Joint Sealants	3

DIVISION 8-OPENINGS

081113	Hollow Metal Doors and Frames	7
083113	Access Doors and Frames	3
083323	Overhead Coiling Doors	5
084113	Aluminum-Framed Entrances and Storefronts	9
084413	Glazed Aluminum Curtain Walls	6
087100	Door Hardware	14
088000	Glazing	10
088300	Mirrors	3

DIVISION 9-FINISHES

092900	Gypsum Board	6
093100	Ceramic Tile	4
095100	Cementitious Wood-Fiber Ceilings	4
095120	Acoustical Tile Ceilings	4
096513	Resilient Wall Base and Accessories	3
096813	Carpet Tile	4
099113	Exterior Painting	4
099123	Interior Painting	5
099300	Staining and Transparent Finishing	4
099600	High-Performance Coatings	5

DIVISION 10-SPECIALTIES

101100	Visual Display Surfaces	3
101400	Signage	3
101416	Plaques	4
101419	Dimensional Letter Signage	4
102113	Phenolic-Core Toilet Compartments	5
102239	Folding Panel Partitions	4
102800	Toilet and Bath Accessories	3
104413	Fire Protection Cabinets	4
104416	Fire Extinguishers	3

DIVISION 11-EQUIPMENT

111313	Loading Dock Bumpers	2
115213	Projection Screens	2

DIVISION 12-FURNISHINGS

122413	Roller Window Shades	4
123661	Solid Surfacing Countertops	4

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DIVISION 22-PLUMBING

220100	General Mechanical Requirements	6
220500	Basic Mechanical Materials and Methods	6
220600	Hangers and Supports	3
220800	Piping Insulation	3
220850	Ductwork Insulation	2

221100	General-Duty Valves	2
221113	Facility Water Distribution Piping	11
221400	Piping Systems	6
221500	Geothermal Well Field Systems	3
221850	Hydronic Pumps	2
221890	HVAC Water Treatment	1
223000	Fire Protection Systems	4
224100	Plumbing Fixtures	3
224300	Plumbing Specialties	2
224850	Water Heaters	2
227330	Energy Recovery Ventilators	2
227790	Indoor Water Source Heat Pumps	3
228150	Metal Ductwork	5
228200	Duct Accessories and HVAC Specialties	2
228350	Power Ventilators	1
228550	Diffusers, Registers, and Grilles	2
229000	Building Managements System	24
229300	Mechanical Systems Commissioning	1
229500	Testing, Adjusting, and Balancing	8

DIVISION 23-HEATING VENTILATING AND AIR CONDITIONING Not Used

DIVISION 26- ELECTRICAL

260100	General Electrical Requirements	7
260500	Basic Electrical Materials and Methods	4
260600	Grounding and Bonding	2
260720	Electrical Supports	2
260750	Electrical Identification	1
261200	Conductors and Cables	2
261300	Raceways and Boxes	4
261400	Wiring Devices	2
261450	Lighting Control Devices	2
264100	Safety Switches	1
264420	Panelboards	5
265110	Lighting Fixtures	2
266100	Data and Communications	14
269000	Fire Detection and Alarm System	15

DIVISION 27-COMMUNICATIONS Not Used

DIVISION 28-ELECTRONIC SAFETY AND SECURITY Not Used

DIVISION 31-EARTHWORK

311000	Site Clearing	5
312000	Earth Moving	14
313116	Termite Control	2

DIVISION 32-EXTERIOR IMPROVEMENTS

321216	Asphalt Pavement	9
321313	Concrete Paving	14
321316	Decorative Concrete Paving	11
321373	Concrete Paving Joint Sealants	5
328400	Planting Irrigation	8
329113	Soil Preparation	9
329200	Turf & Grasses	9
329300	Plants	14

DIVISION 33-UTILITIES

334100	Storm Utility Drainage Piping	9
334600	Subdrainage	3

TECHNICAL SPECIFICATIONS INDEX:**VOLUME 3 of 3****SHEPHERD OF THE HILLS FISH HATCHERY STORAGE BUILDING IMPROVEMENTS
PROJECT JOB NUMBER 56-01-64****DIVISION 2-EXISTING CONDITIONS**

024116	Structure Demolition	5
024120	Water Supply Well Abandonment	2

DIVISION 3-CONCRETE

033000	Cast-in-Place Concrete	17
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DIVISION 4-MASONRY Not Used**DIVISION 5-METALS**

055000	Metal Fabrications	7
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DIVISION 6-WOOD, PLASTICS, AND COMPOSITES

061000	Rough Carpentry	7
061600	Sheathing	3
061760	Metal-Plate-Connected Wood Trusses	5
062013	Exterior Finish Carpentry	5
064020	Interior Architectural Woodwork	10
066400	Plastic Paneling	3

DIVISION 7-THERMAL AND MOISTURE PROTECTION

072100	Building Insulation	5
074113	Metal Roof Panels	10
074213	Metal Wall Panels	8
076200	Sheet Metal Flashing and Trim	8
078413	Penetration Firestopping	6
079200	Joint Sealants	7

DIVISION 8-OPENINGS

081100	Steel Door and Frames	5
083613	Sectional Doors	9
085200	Wood Windows	7
087100	Door Hardware	12

DIVISION 9-FINISHES

092600	Gypsum Board Assemblies	5
096530	Resilient Wall Base and Accessories	4
099120	Interior Painting	5

DIVISION 10-SPECIALTIES

101400	Signage	6
105220	Fire Extinguishers, Cabinets, and Accessories	2
108010	Toilet and Bath Accessories	5

DIVISION 11-EQUIPMENT Not Used**DIVISION 12-FURNISHINGS** Not Used**DIVISION 13-SPECIAL CONSTRUCTION** Not Used**DIVISION 14-CONVEYING EQUIPMENT** Not Used**DIVISION 21-FIRE SUPPRESSION** Not Used**DIVISION 22-PLUMBING**

220000	General Requirements for Plumbing	4
220050	Basic Mechanical Materials and Methods for Plumbing	7
220410	Plumbing Piping	8
221101	Boring and Jacking	3
221113	Facility Water Distribution Piping	13
221313	Sewage Lines and Manholes	3
224400	Plumbing Fixtures and Specialties	7

DIVISION 23-HEATING VENTILATING AND AIR CONDITIONING

230000	General Requirements for HVAC	4
230500	Basic Mechanical Materials and Methods	5
230762	Unit Heaters	3
230838	Power Ventilators	2

DIVISION 26- ELECTRICAL

260500	Common Work Results for Electrical	6
260519	Low-Voltage Electrical Power Conductors and Cables	3
260526	Grounding and Bonding for Electrical Systems	3
260533	Raceway and Boxes For Electrical Systems	5
260750	Voice and Data Communication	9
262416	Panelboards	6
262726	Wiring Devices	4
262816	Enclosed Switches	3
265119	LED Interior Lighting	4

DIVISION 27-COMMUNICATIONS Not Used**DIVISION 28-ELECTRONIC SAFETY AND SECURITY** Not Used**DIVISION 31-EARTHWORK**

311000	Site Clearing	3
312000	Earth Moving	13

DIVISION 32-EXTERIOR IMPROVEMENTS

329200	Turf and Grasses	4
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DIVISION 33-UTILITIES

330500	Common Work Results for Utilities	8
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PROJECT MANUAL
Volume 1 of 3

SHEPHERD OF THE HILLS FISH HATCHERY

CONSERVATION CENTER REPLACEMENT
PROJECT JOB NUMBER: 56-01-71

AND

STORAGE BUILDING IMPROVEMENTS
PROJECT JOB NUMBER: 56-01-64

TANEY COUNTY, MISSOURI

Designed by: Missouri Department of Conservation
Design and Development

Bid Date: January 26, 2017

**MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT
2901 WEST TRUMAN BLVD., PO BOX 180
JEFFERSON CITY, MISSOURI 65102**



DOCUMENT 000107 - SEALS PAGE

**SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT
PROJECT JOB NUMBER 56-01-71**

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Civil Engineer:

Division 22-PLUMBING

221113 Facility Water Distribution Piping

Division 31-EARTHWORK

311000 Site Clearing

312000 Earth Moving

Division 32-EXTERIOR IMPROVEMENTS

321216 Asphalt Paving

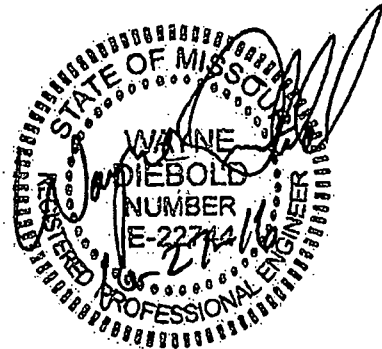
321313 Concrete Paving

321373 Concrete Paving Joint Sealants

Division 33-UTILITIES

334100 Storm Utility Drainage Piping

334600 Subdrainage



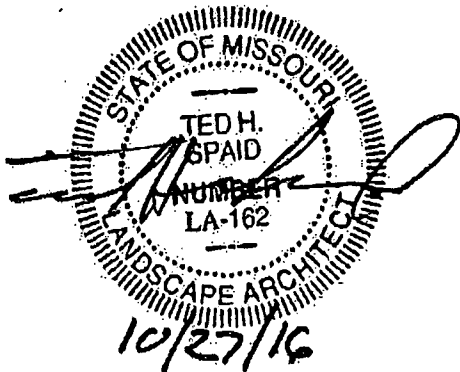
B. Landscape Engineer

DIVISION 1- GENERAL REQUIREMENTS

015639 Temporary Tree and Plant Protection

DIVISION 32- EXTERIOR IMPROVEMENTS

321313	Concrete Paving
321316	Decorative Concrete Paving
328400	Planting Irrigation
329113	Soil Preparation
329200	Turf and Grasses
329300	Plants



C. Structural Engineer

DIVISION 3-CONCRETE

033000 Cast-in-Place Concrete

DIVISION 4- MASONRY

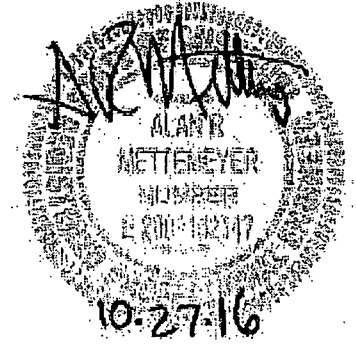
042000 Unit Masonry

DIVISION 5- METALS

051200 Structural Steel Framing
053100 Steel Decking
054000 Cold Formed Metal Framing
055000 Metal Fabrications
057300 Decorative Metal Railings

DIVISION 6- WOOD, PLASTICS, AND COMPOSITES

061000 Rough Carpentry
061200 Structural Insulated Panels
061600 Sheathing
061800 Glued Laminated Construction



D. Architectural

DIVISION 2- EXISTING CONDITIONS

024118 Cutting and Patching
024119 Selective Structure Demolition

DIVISION 3- CONCRETE

033543 Polished Concrete Finishing

DIVISION 4- MASONRY

047200 Cast Stone Masonry

DIVISION 6- WOOD, PLASTICS, AND COMPOSITES

062013 Exterior Finish Carpentry
062023 Interior Finish Carpentry
064113 Wood-Veneer-Faced Architectural Cabinets
064116 Plastic Laminated Faced Architectural Cabinets and Countertops

DIVISION 7- THERMAL AND MOISTURE PROTECTION

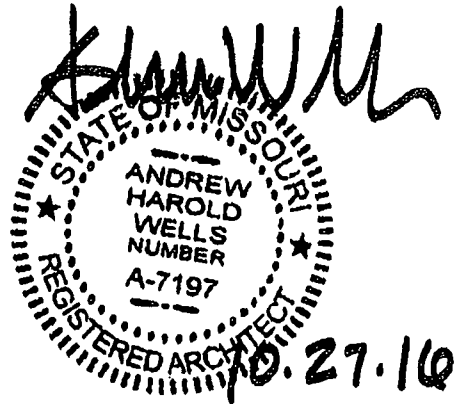
071113 Bituminous Dampproofing
071900 Water Repellents
072100 Thermal Insulation
072500 Weather Barriers
072610 Underslab Vapor Barrier
074113 Standing Seam Metal Roof Panels
074213 Metal Plate Wall Panels
074646 Fiber-Cement Siding
076200 Sheet Metal Flashing And Trim
079200 Joint Sealants
079219 Acoustical Joint Sealants

DIVISION 9- FINISHES

092900 Gypsum Board
093100 Ceramic Tile
095100 Cementitious Wood Fiber Ceilings
095120 Acoustical Tile Ceiling
096513 Resilient Wall Base and Accessories
096183 Carpet Tile
099113 Exterior Painting
099123 Interior Painting
099300 Staining and Transparent Finishing
099600 High-Performance Coatings

DIVISION 10- SPECIALTIES

101100 Visual Display Surfaces
101400 Signage
101416 Plaques
101419 Dimensional Letter Signage
102113 Phenolic-Core Toilet Compartments



102239	Folding Panel Partitions
102800	Toilet, Bath, and Laundry Accessories
104413	Fire Protection Cabinets
104416	Fire Extinguishers

DIVISION 11- EQUIPMENT

111313	Loading Dock Bumpers
115213	Projection Screens

DIVISION 12- FURNISHINGS

122413	Roller Window Shades
123661	Simulated Stone Countertops

DIVISION 31- EARTHWORK

313116	Termite Control
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E. Mechanical Engineer

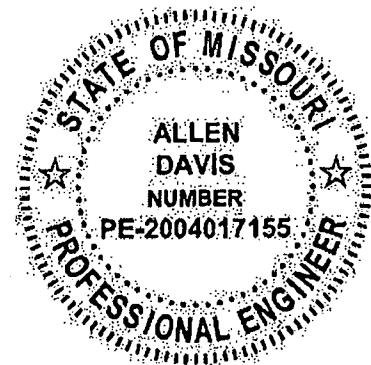
Division 22- PLUMBING

220100	General Mechanical Requirements
220500	Basic Mechanical Materials and Methods
220600	Hangers and Supports
220800	Piping Insulation
220850	Ductwork Insulation
221100	General Duty Valves
221400	Piping Systems
221500	Geothermal Well Field System
221850	Hydronic Pumps
221870	Hydronic Specialties
221890	HVAC Water Treatment
223000	Fire Protection System
224100	Plumbing Fixtures
224300	Plumbing Specialties
224850	Water Heaters
227330	Energy Recovery Ventilators
227790	Indoor Water Source Heat Pumps (3 to 10 tons)
228150	Metal Ductwork
228200	Duct Accessories and HVAC Special Tiles
228350	Power Ventilators
228550	Grilles, Registers and Diffusers
229000	Temperature Controls
229300	Mechanical Systems Commissioning
229500	Testing, Adjusting, and Balancing

A. Electrical Engineer:

DIVISION 26- ELECTRICAL

260100	General Electrical Requirements
260500	Basic Electrical Materials and Methods
260600	Grounding and Bonding
260720	Electrical Supports
260750	Electrical Identification
261200	Conductors and Cables
261300	Raceways and Boxes
261400	Wiring Devices
261450	Lighting Control Devices
264100	Safety Switches
264420	Panelboards
265110	Lighting Fixtures
266100	Data and Communications
269000	Fire Alarm System



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DOCUMENT 000107 - SEALS PAGE

**SHEPHERD OF THE HILLS FISH HATCHERY STORAGE BUILDING IMPROVEMENTS
PROJECT JOB NUMBER 56-01-64**

1.1 DESIGN PROFESSIONALS OF RECORD

1. Architect:

DIVISION 01 – GENERAL REQUIREMENTS

011000 SUMMARY
012200 UNIT PRICES
013100 PROJECT MANAGEMENT AND COORDINATION
013300 SUBMITTAL PROCEDURES
014800 CONSTRUCTION SURVEY STAKING
015000 TEMPORARY FACILITIES AND CONTROLS
015800 INFORMATION SIGN
017300 EXECUTION
017700 CLOSEOUT PROCEDURES
017839 PROJECT RECORD DOCUMENTS

DIVISION 02 – EXISTING CONDITIONS

024116 STRUCTURE DEMOLITION

DIVISION 03 – CONCRETE

033000 CAST-IN-PLACE CONCRETE

DIVISION 05 – METALS

055000 METAL FABRICATIONS

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

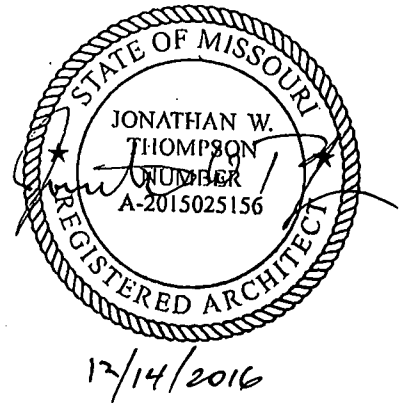
061000 ROUGH CARPENTRY
061600 SHEATHING
061760 METAL-PLATE CONNECTED WOOD TRUSSES
062013 EXTERIOR FINISH CARPENTRY
064020 INTERIOR ARCHITECTURAL WOODWORK
066400 PLASTIC PANELING

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

072100 BUILDING INSULATION
074113 METAL ROOF PANELS
074213 METAL WALL PANELS
076200 SHEET METAL FLASHING AND TRIM
078413 PENETRATION FIRESTOPPING
079200 JOINT SEALANTS

DIVISION 08 – OPENINGS

081100 STEEL DOORS AND FRAMES
083613 SECTIONAL DOORS
085200 WOOD WINDOWS
087100 DOOR HARDWARE



DIVISION 09 – FINISHES

092600 GYPSUM BOARD ASSEMBLIES
096530 RESILIENT WALL BASE AND ACCESSORIES
099120 INTERIOR PAINTING

DIVISION 10 – SPECIALTIES

101400 SIGNAGE
105220 FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES
108010 TOILET AND BATH ACCESSORIES

2. Civil Engineer:

DIVISION 02 – EXISTING CONDITIONS

024116 STRUCTURE DEMOLITION
024120 WATER SUPPLY WELL ABANDONMENT

DIVISION 03 – CONCRETE

033000 CAST-IN-PLACE CONCRETE

DIVISION 22 - PLUMBING

221101 BORING AND JACKING
221113 FACILITY WATER DISTRIBUTION PIPING
221313 SEWAGE LINES AND MANHOLES

DIVISION 31-EARTHWORK

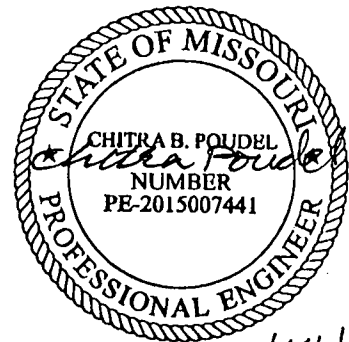
311000 SITE CLEARING
312000 EARTH MOVING

DIVISION 32 – EXTERIOR IMPROVEMENTS

329200 TURF AND GRASSES

DIVISION 33 – UTILITIES

330500 COMMON WORK RESULTS FOR UTILITIES



12/14/2016

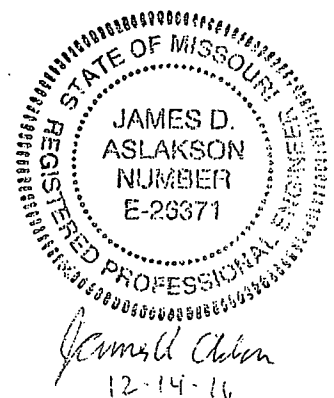
3. Mechanical Engineer:

DIVISION 22 - PLUMBING

220000 GENERAL REQUIREMENTS FOR PLUMBING
220050 BASIC MECHANICAL MATERIALS AND METHODS FOR PLUMBING
220410 PLUMBING PIPING
224400 PLUMBING FIXTURES AND SPECIALTIES

DIVISION 23 – HEATING VENTILATIONG AND AIR CONDITIONING

230000 GENERAL REQUIREMENTS FOR HVAC
230500 BASIC MECHANICAL MATERIALS AND METHODS
230762 UNIT HEATERS
230838 POWER VENTILATORS

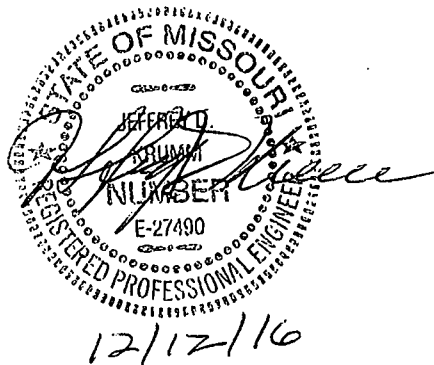


4. Electrical Engineer:

DIVISION 26 - ELECTRICAL

260500 COMMON WORK RESULTS FOR ELECTRICAL
260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260750 VOICE AND DATA COMMUNICATION
262416 PANELBOARDS
262726 WIRING DEVICES
262816 ENCLOSED SWITCHES
295119 LED INTERIOR LIGHTING

END OF DOCUMENT 000107



SECTION 000115 - LIST OF DRAWING SHEET

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings listed on the Drawing Index page of the drawing set titled Shepherd of the Hills Fish Hatchery Conservation Center Replacement and Storage Building Improvements dated December 2016, as modified by subsequent Addenda and Contract modifications
- B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

<u>TITLE</u>	<u>SHEET #</u>			
COVER SHEET	--			
<u>Project 1:</u> Shepherd of the Hills Fish Hatchery Conservation Nature Center				
Project Number: 56-01-71				
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NORTH CENTRAL DEMOLITION PLAN	C1.5	7	of	148
CENTRAL DEMOLITION PLAN	C1.6	8	of	148
SOUTHWEST DEMOLITION PLAN	C1.7	9	of	148
SOUTHEAST DEMOLITION PLAN	C1.8	10	of	148
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NORTH CENTRAL SITE PLAN	C2.2	13	of	148
CENTRAL SITE PLAN	C2.3	14	of	148
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SOUTHEAST GRADING PLAN	C4.5	30	of	148
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LAYOUT PLAN	L-114	47	of	148
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Project Number: 56-01-64

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END OF SECTION 000115

DOCUMENT 001113 – ADVERTISEMENT FOR BIDS

1.1 OWNER:

- A. The Missouri Department of Conservation
Design and Development Division
Jefferson City, Missouri

2.1 PROJECT:

- A. Job Number: 56-01-71 and 56-01-64
- B. Job Title: SHEPHERD OF THE HILLS FISH HATCHERY
CONSERVATION CENTER REPLACEMENT AND STORAGE
BUILDING IMPROVEMENTS
Taney County, Missouri
- C. Address: 483 Hatchery Rd, Branson, MO 65616

3.1 BIDS WILL BE RECEIVED:

- A. Date/Time: January 26, 2017 at 2:00 PM
- B. Place: Missouri Department of Conservation, PO Box 180, 2901 West Truman
Boulevard, Jefferson City, MO 65102

4.1 DESCRIPTION:

- A. Project #56-01-71 consists of the construction of an approximately 11,776 square foot conservation center, including grading and landscape enhancements, road improvements, walkable paths, and parking improvements.

Project #56-01-64 consists of the demolition of an existing field house/bunk house, construction of a new storage building, and the construction of a new 6" domestic water line and a new fire hydrant and supply line.

Estimate: \$5,200,000 to \$6,700,000

- B. Minority Goals: MBE 10%, WBE 5% (for projects of \$100,000 or More)

5.1 PRE-BID MEETING – NON-MANDATORY

- A. Place/Time: **December 21, 2016 and January 10, 2017; 10:00 am;**
Shepherd of the Hill Conservation Visitor Center
483 Hatchery Rd, Branson, MO 65616.

6.1 PLANS, SPECIFICATIONS, & WEBSITE

- A. To be listed as a plan holder, you must obtain a paper set of bid documents. Drawings, specifications and other related contract information must be obtained at American Document Solutions, 1400 Forum Blvd., Suite 1C, Columbia, Missouri 65203, telephone (573) 446-7768; fax (573) 355-5433. Paper bid sets are available for a non-refundable fee of \$100.00 per set. Checks shall be made payable to "ADS". Shipping costs are the responsibility of the contractor. A printable planholders list and electronic sets for viewing only are available at <http://mdc.adsmo.net>.

7.1 POINT OF CONTACT

- A. Bidding Questions: Greg Trinkle, Contract Specialist,
Phone no. 573/522-0136, or fax 573/522-2324,
E-mail Greg.Trinkle@mdc.mo.gov
- B. Design Questions: Jonathan W. Thompson, AIA
Phone no. 573/522-4115 ext. 3758 or fax 573/522-2324,
E-mail jon.thompson@mdc.mo.gov

8.1 GENERAL INFORMATION

- A. The State reserves the right in its sole discretion to reject any and all bids and to waive all informalities in bids. No bid may be withdrawn after the time specified for bid opening time. The contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the MO Dept. of Labor and Industrial Relations and as set out in the detailed plans and specifications
- B. Bid results are available after 4:00 PM the day of the bid opening by calling: (573) 522-0110.

DOCUMENT – 002113 - INSTRUCTIONS TO BIDDERS

1.1 GENERAL

ARTICLE 1 - SPECIAL NOTICE TO BIDDERS

- A. These specifications have bound hereto a complete set of bidding forms. These are for the bidder's convenience only and are not to be detached from the specifications or filled out or executed. One unbound proposal form will be furnished to each bidder and shall be executed and submitted in a sealed envelope provided.

ARTICLE 2 - CONTRACT DOCUMENTS

- A. The number of sets obtainable by any one (1) party may be limited in accordance with available supply.
- B. Copies of drawings and specifications are on file at the Missouri Department of Conservation, Design and Development Division, 2901 West Truman Blvd., P.O. Box 180, Jefferson City, Missouri 65102 for the convenience of subcontractors and suppliers and may be seen and examined during regular business hours.

ARTICLE 3 - BIDDER'S OBLIGATIONS

- A. Bidders must carefully examine the entire site of the work and shall make all necessary investigations to inform themselves thoroughly as to the facilities available as well as to all the difficulties involved in the completion of all work in accordance with the specifications and the plans, which includes but is not limited to environmental considerations, potentially hazardous materials, zoning, and compliance with all state and federal laws and regulations. Bidders are also required to examine all maps, plans and data mentioned in the specifications. No plea of ignorance of conditions that exist, or that may hereafter exist, or of conditions or difficulties that may be encountered in the execution of the work under this contract will be accepted as an excuse for any failure or omission on the part of the Contractor to fulfill in every detail all of the requirements of the contract, nor will such pleas of ignorance be accepted as a basis for any claims for extra compensation, or additional time to complete the contract.
- B. Under no circumstances will a contractor give plans and specifications to another contractor. Any proposal received from a contractor whose name does not appear on the list of bidders having made a payment for the plans and specifications will be subject to rejection.

ARTICLE 4 - INTERPRETATIONS

- A. No oral interpretations will be made to any bidder as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction. Every request for interpretation shall be made in writing and submitted with all supporting documents not less than seven (7) calendar days before opening of bids. The request shall be sent directly to the Design and Development Division, Missouri Department of Conservation, 2901 West Truman Blvd., P.O. Box 180, Jefferson City, Missouri 65102. Every interpretation made to a bidder will be in the form of an addendum and will be sent as promptly as is practicable to all persons to whom plans and specifications have been issued. All such addenda shall become part of the contract documents. No communication, oral or otherwise, concerning the interpretation of plans and specifications shall be binding on Owner, unless provided in the form of an addendum as set forth in this section.

ARTICLE 5 - PROPOSALS AND BIDDING PROCEDURES

- A. All proposals shall be submitted without modification or reservation on the proposal form with each space properly completed. Proposals not on the provided proposal form will be rejected. Modifications of the proposals after delivery to the Owner will not be accepted unless submitted on a new proposal form, and delivered to the Owner in lieu of the original proposal prior to the time set for opening bid proposals.
- B. All proposals shall be received by January 26, 2017 at 2:00 PM to the mailing address of Missouri Department of Conservation, PO Box 180, Jefferson City, MO 65102 or the physical address of Missouri Department of Conservation, 2901 West Truman Boulevard, Jefferson City, MO 65109 in order to be considered.

- C. All proposals shall be considered to be submitted when they are received by the Missouri Department of Conservation, at the above identified address. All untimely bid proposals will be rejected at the sole discretion of the Owner.
- D. All proposals shall be accompanied by a bid bond, executed by the bidder and a duly authorized surety company, or certified check, cashier's check or bank draft made payable to the Missouri Department of Conservation in the amount as set forth in Document 004113 – Bid Form. Failure of the bidder to submit the full amount required shall be sufficient cause to reject the bid. The bidder agrees that the proceeds of the check, draft or bond shall become the property of the Missouri Department of Conservation, if for any reason the bidder withdraws the bid after the time established for opening bids, or if on notification of award refuses or is unable to execute the contract tendered by the Department, or fails to provide an acceptable performance and payment bond, or fails to provide evidence of required insurance coverage and provide required copies of affirmative action plans within fourteen (14) consecutive calendar days after such tender. It is further agreed that, if a contract is not awarded within thirty (30) days after the opening of bids, a bidder may file a written notice with the Owner for the withdrawal of the bid.
- E. The check, draft or bond submitted by the successful bidder will be returned after the receipt of an acceptable performance and payment bond and execution of formal contract. Checks, drafts or bonds of all unsuccessful bidders will be returned within a reasonable time after it is determined that the bid represented by same will receive no further consideration by the Missouri Department of Conservation.

ARTICLE 6 - SIGNING OF PROPOSALS

- A. Proposals from an individual(s) shall be signed in the name of the individual(s) doing business.
- B. Proposals from a partnership shall be signed in the firm name by at least one partner or in the firm name by Attorney-in-fact. If signed by Attorney-in-fact there shall be attached to the proposal a Power of Attorney evidencing authority to sign the proposal, dated and executed by all partners of the firm.
- C. Proposals from a limited liability company shall have the correct limited liability company name thereon and the signature of a managing member/member of the limited liability company manually written. Title of the person signing on behalf of the limited liability company shall appear along with typed name of said individual. The limited liability company's Operating Agreement will be provided to the Owner upon request. If the limited liability company is organized in a state other than Missouri, a properly certified copy of its Certificate of Organization to do business in the State of Missouri shall be attached.
- D. Proposals from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written. Title of the office held by the person signing on behalf of the corporation shall appear along with typed name of said individual. The corporate license number of the corporation shall be provided and, if the corporation is organized in a state other than Missouri, A Certificate of Authority to do business in the State of Missouri shall be attached.
- E. Proposals submitted under a fictitious name will not be considered.

ARTICLE 7 - RECEIVING BIDS

- A. Proposals are to be presented in sealed envelopes (provided by Owner) which shall be plainly marked with project title, bid date and bid time and delivered to the place specified in the Advertisement for Bids. Bidders shall be responsible for actual delivery of proposals during business hours, and it shall not be sufficient to show that a proposal was dispatched in time to be received before scheduled closing time for receipt of the proposal. Proposals are deemed submitted when received by the Department at the location specified in the Advertisement for Bids.
- B. Bids received prior to the time of opening will be kept unopened. The office whose duty is to receive bids will decide when the specified time for opening bids has arrived, and no bid received thereafter will be considered. No Department employee or agent shall be responsible for the premature opening of a bid, or improperly submitted bids.
- C. Bidders are cautioned to allow ample time for transmittal of bids by mail or otherwise. If bid is mailed, bidder should secure correct information relative to the probable time of arrival and distribution of mail at the place where bid is to be received, and make due allowance for possible delays.

- D. Proposals will be received separately or in combination as shown in and required by the Form of Proposal. Proposals will be completed so as to include insertion of all amounts for bid alternate(s), unit prices and cost accounting data, etc. Failure to complete all required information may be cause for rejection of bid.
- E. Bidder's attention is directed to the fact that no bid will be accepted or considered if delivered after the specified time for receiving bids.
- F. No telephonic, telegraphic, electronic mail, facsimile (FAX), or similar bid transmissions will be accepted or allowed. Bids shall be delivered in person, by U.S. Mail, or courier.
- G. Bidder's proposal price shall include all city, county, state and federal taxes, including but not limited to, sales, excise, employment, and similar taxes which may be lawfully assessed in connection with the performance of work and purchase of materials to be incorporated in the work.
- H. The completed forms shall be submitted without interlineation, alteration or erasure. If contractor desires additional copies of forms, a request may be submitted.
- I. No Contractor shall stipulate in the bid any conditions not contained in the specifications or standard proposal/contract form contained in the contract documents. Failure to comply with this requirement may, at the Owner's sole discretion, lead to the rejection of the bid.
- J. The Owner reserves the right to waive informalities in proposals and reject any or all proposals at Owner's sole discretion.

ARTICLE 8 - WITHDRAWAL OR REVISION OF BIDS

- A. Bidders may withdraw proposals by submitting a revised proposal or a request for withdrawal of the proposal in writing at the address specified in the proposal, prior to the time set for opening bid proposals. Revisions to proposals after the original proposal is delivered to the Owner will not be accepted unless submitted on a new proposal form and delivered to the Owner in lieu of the original proposal prior to the time set for opening bid proposals. Written revisions shall be sealed for confidentiality. The revision or request for withdrawal shall identify the project name, number, and bid date. The use of facsimile (FAX) or email transmission is not acceptable. Revised proposals or requests for withdrawal of proposals submitted after the time set for opening proposals shall be deemed untimely and will not be accepted.

ARTICLE 9 - STATEMENT OF BIDDER'S QUALIFICATIONS

- A. Each bidder must submit as part of the bid proposal, a statement of bidder's qualifications which is a part of the proposal form. The Owner shall have the right to take such steps as it deems necessary, at Owner's sole discretion, to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner such additional information and data for this purpose as requested. Owner reserves the right in its sole discretion to reject any bid where an investigation or consideration of the information submitted by such bidder does not satisfy the Owner that the bidder is qualified to carry out properly the terms of the contract documents.

ARTICLE 10 - AWARD OF CONTRACT

- A. The Owner, in its sole discretion, reserves the right to reject any and/or all bids and further to waive all informalities in bidding when deemed in the best interest of the State of Missouri.
- B. The Owner, in its sole discretion, reserves the right to let other contracts in connection with the work, including but not by way of limitation, contracts for the furnishing and installation of furniture, equipment, machines, appliances and other apparatus.
- C. In awarding the contract the Owner may take into consideration the bidder's skill, facilities, capacity, experience, responsibility, previous work record and financial standing; and, the necessity of prompt and efficient completion of work herein described. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of the proposal. However, no contract will be awarded to any individual, partnership or corporation, who has had a contract with the State of Missouri declared in default within the preceding twelve months, or who has been debarred from contracting with the State of Missouri.
- D. Award of alternates, if any, will be made in numerical order to result in the maximum amount of work being accepted within available construction funds unless all bids received are such that the order of acceptance of alternates does not affect the determination of the low bidder.

- E. RSMo 285.525 and 285.530 require business entities to enroll and participate in a federal work authorization program in order to be eligible to receive award of any state contract in excess of \$5,000. For all such contracts the business entity must provide a sworn affidavit with supporting documentation that states the business entity is enrolled and participating in such a federal work authorization program, and an affidavit that states the entity does not employ any person who is an unauthorized alien in connection with the contracted services/work. Therefore, submittal of Document – 006350, Affidavit of Work Authorization and appropriate documentation is required before the award of any contract. Information regarding a Memorandum of Understanding which is one form of appropriate documentation is located at <https://e-verify.uscis.gov/enroll/>. In addition, the contractor shall be responsible for ensuring that all subcontractors and suppliers, at any tier associated with this contract, are in compliance with these requirements.
- F. No contract shall be awarded to any transient employer, unless the successful bidder certifies that they have complied with all applicable provisions of Section 285.230-234 RSMo.
- G. Contractor shall require all on-site employees, subcontractors, and all employees of subcontractors to complete the ten-hour training program required by Section 292.675 RSMo.

ARTICLE 11 - FORM OF CONTRACT AND PERFORMANCE/PAYMENT BOND

- A. The forms of the contract and performance/payment bond to be executed are standard forms which are on file with Design and Development Division, Missouri Department of Conservation.
- B. The Owner will prepare and forward copies of the contract and performance/payment bond to the bidder to whom the contract for the work is awarded and such bidder shall return the properly executed prescribed copies of the contract, bond, evidence of required insurance and required copies of affirmative action plan, and work authorization form to the Owner within fourteen (14) consecutive calendar days after their receipt.
- C. No proposal shall be considered binding upon the Owner until the written contract has been properly executed, a satisfactory bond has been furnished, evidence of required insurance coverage has been received, proof of compliance with Section 285.530 RSMo. has been provided, and an appropriate affirmative action plan and work authorization form submitted. Failure to execute and return the contract and associated documents within the prescribed period of time shall be treated, at the option of the Owner, as a breach of bidder's obligation and the Owner shall be under no further obligation to bidder.
- D. Bids will only be considered from legal business entities such as: individual(s), partnership, limited liability company, and corporation. Bids will not be considered if submitted under a fictitious name.
- E. Any successful bidder which is a limited liability company organized in a state other than Missouri shall furnish to the Owner, attached to the Proposal, a properly certified copy of its current Certificate of Good Standing and Certificate of Organization to do business in the State of Missouri, such certificates to remain on file with the Owner. No contract will be awarded by the Owner unless such certificates are furnished by the bidder.
- F. Any successful bidder which is a corporation organized in a state other than Missouri shall furnish to the Owner, attached to the Proposal, a properly certified copy of its current Certificate of Good Standing and Certificate of Authority to do business in the State of Missouri, such certificates to remain on file with the Owner. No contract will be awarded by the Owner unless such certificates are furnished by the bidder.
- G. Any successful bidder which is a corporation, limited liability company, or limited partnership organized in the State of Missouri shall furnish at its own cost to the Owner, a current Certificate of Good Standing issued by the Secretary of State, such certificate to remain on file with the Owner. No contract will be awarded by the Owner unless such certificate is furnished by the bidder.

ARTICLE 12 - CONTRACT SECURITY

- A. The Contractor shall furnish a performance/payment bond in an amount at least equal to 100% of the contract price as security for the faithful performance of the contract and for payment of all persons performing labor on the project and furnishing materials in connection therewith under the contract as set forth in the standard form of performance/payment bond. The Surety on such bond shall be a duly authorized surety company satisfactory to the Owner.
- B. The Contractor shall furnish at no cost to the Owner, if requested, a properly certified copy of the current Certificate of Authority to transact business in the State of Missouri of the surety company executing the required bond, such certificate to remain on file with the Owner.

- C. If at any time the Owner, for justifiable cause, shall be or become dissatisfied with any surety or sureties then upon the performance/payment bond, the Contractor shall within five (5) days after notice from the Owner, substitute an acceptable bond signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Contractor. No further payments shall be due nor made until the new acceptable bond is furnished to the Owner.

ARTICLE 13 - TIME OF COMPLETION AND LIQUIDATED DAMAGES

- A. Bidders must agree to commence work upon a date specified by the Owner in the "Notice to Proceed", and the entire work shall be completed within the time specified. Liquidated damages for delay in completion of the work shall be as prescribed (See Article 14 of General Conditions).

ARTICLE 14 - NUMBER OF CONSTRUCTION DOCUMENTS

- A. The Owner will furnish the Contractor a copy of the executed contract.
- B. The Owner will furnish the Contractor free of charge the number of complete sets of plans and specifications for the work and all applicable subdivisions thereof, as set forth in the general conditions.

ARTICLE 15 - LIST OF SUBCONTRACTORS AND MATERIAL SUPPLIERS

- A. Each bidder must submit as part of the bid proposal, a list of subcontractors and material suppliers to be used in performing the work. The list shall specify the single designated subcontractor or material supplier's name and address for each category of work listed in the Proposal. If work within a category will be performed by more than one subcontractor, list the name and address of each subcontractor and specify the exact portion of the work to be done. If acceptance/nonacceptance of alternates will affect the designation of a subcontractor or material supplier, provide information for each affected category.
- B. Failure to include a complete subcontractor and material supplier list may be grounds for rejection of the bid proposal.

ARTICLE 16 - NOTICE TO NON-MISSOURI FIRMS

- A. Pursuant to the provisions of Section 34.076 RSMo 1986, for all bids in excess of \$5,000.00, Missouri contractors on public works are given preference to the extent your domiciliary state gives preference to domiciliary contract bidders on public works. You may be required to submit an audited financial statement should your domiciliary state require it of a Missouri bidder on public work.

ARTICLE 17 - MINORITY BUSINESS ENTERPRISE/WOMEN BUSINESS ENTERPRISE (MBE/WBE) PARTICIPATION

- A. For bids in amounts greater than or equal to one hundred thousand dollars (\$100,000), the following provisions shall apply:
1. MBE/WBE Defined: Minority Business Enterprises (hereinafter "MBE") and Women Business Enterprises (hereinafter "WBE") shall mean those businesses certified as MBE/WBE by the Missouri Office of Administration or any other State of Missouri agency or department, in addition to those businesses certified as MBE/WBE by any Federal agency or department.
 2. MBE/WBE Percentage Goal:
 - a. The bidder shall have as a goal subcontracting not less than **10% MBE AND 5% WBE** of the awarded contract price to MBE/WBE(s).
 3. Computation of MBE/WBE Percent Goal Participation:
 - a. The total dollar value of the work granted to the MBE/WBE by the successful bidder is counted towards the applicable goal of the entire contract.
 - b. A bidder may count toward his/her MBE/WBE goal only expenditures to MBE/WBEs that perform a commercially useful function in the work of a contract. A MBE/WBE is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work contract and carrying out its responsibilities by actually performing, managing and supervising the work involved.

- c. A bidder may count toward its MBE/WBE goals expenditures for materials and supplies obtained from MBE/WBE suppliers and manufacturers, provided that the MBE/WBE assumes the actual and contractual responsibility for the provision of the materials and supplies.
 - (1) The bidder may count its entire expenditure to a MBE/WBE manufacturer. A manufacturer shall be defined as an individual or firm that produces goods from raw materials or substantially alters them before resale.
 - (2) The bidder may count one hundred (100%) percent of its expenditures to MBE/WBE suppliers that are not manufacturers provided that the MBE/WBE supplier performs a commercially useful function, as defined above in the supply process.
 - d. A bidder may count towards his/her MBE/WBE goals that portion of the total dollar value granted to a certified joint venture equal to the percentage of the ownership and control of the MBE/WBE partner in the joint venture.
4. Certification by bidder of MBE/WBE Subcontractors:
- a. The bidder shall submit with his/her bid proposal the information requested in the MBE/WBE Compliance Evaluation for every MBE/WBE subcontractor the bidder intends to use on the contract work.
 - b. If the MBE/WBE subcontractor that the bidder proposes to use on the project is not certified, the bidder shall submit with his/her proposal the information requested in the MBE/WBE Eligibility Determination. If the proposed subcontractor is certified as a MBE/WBE firm by the federal government, any state or government agency or any State of Missouri city or county government agency, the bidder shall so note and provide particulars.
 - c. If the MBE/WBE subcontractor that the bidder intends to use is a joint venture, and one (1) or more co-venturers is not certified as a MBE/WBE, the bidder shall submit with his/her proposal the information requested in the MBE/WBE Eligibility Determination - Joint Ventures.
5. Waiver of MBE/WBE Participation:
- a. The bidder is required to make a good faith effort to locate and contract with MBE/WBEs. If a bidder has made a good faith effort to obtain the target MBE/WBEs participation and has failed, he/she may submit with his/her bid proposal the information requested in MBE/WBE Application for Waiver. The Owner will review the bidder's actions as set forth in the bidder's application for waiver, and any other factors deemed relevant by the Owner, to determine if a good faith effort has been made to meet the applicable percentage goal. If the bidder is judged not to have made a good faith effort, the bid shall be rejected. Bidders who demonstrate that they have made a good faith effort to include MBE/WBE participation will be awarded the contract regardless of the percent of MBE/WBE participation, provided the bid is otherwise acceptable.
 - b. In reaching his/her determination of good faith, the Owner may evaluate, but is not limited to, the following factors:
 - (1) Attendance at pre-bid meetings scheduled by the Owner to inform bidders and MBE/WBEs of contracting and subcontracting opportunities and responsibilities associated with MBE/WBE participation;
 - (2) Attempts by the bidder to advertise in general circulation trade association and minority focus media concerning subcontracting opportunities;
 - (3) Attempts to provide written notice to specific MBE/WBEs that their services were being solicited, in sufficient time to allow for their effective participation;
 - (4) Follow-up attempts by the bidder to the initial solicitation(s) to determine with certainty whether MBE/WBEs were interested;
 - (5) The extent to which the bidder divided work into projects suitable for subcontracting to MBE/WBEs;
 - (6) Whether the bidder provided interested MBE/WBEs with sufficiently detailed information about the plans, specifications and requirements about the contract;

- (7) Efforts by the bidder to negotiate in good faith with MBE/WBEs for specific sub-bids. Documentation should include names, addresses, and telephone numbers of firms contacted, a description of all information provided the MBE/WBEs, and an explanation as to why agreements were not reached;
 - (8) Reasons for rejecting MBE/WBE's proposal
 - (9) The bidder's initiatives to encourage and develop MBE/WBEs
 - (10) The efforts of the bidder to help the MBE/WBE overcome and legal or other barriers impeding the participation of MBE/WBE's in the construction contract;
 - (11) The availability of MBE/WBEs and the adequacy of the bidder's efforts to increase the participation of such businesses provided by the persons and organizations consulted by the bidder.
- B. The Owner reserves the right to provide bidders the opportunity to correct or amplify information concerning MBE/WBE goals. The additional information shall be transmitted within 48 hours of the request from the Owner.

END OF DOCUMENT 002113

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DOCUMENT 003119 - EXISTING CONDITION INFORMATION

1.1 EXISTING CONDITION INFORMATION

- A. This Document with its referenced attachments is part of the Contract. They provide information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. They are made available for Bidders' convenience and information.
- B. A soil report prepared by Palmerton & Parrish, Inc., dated February 3, 2012, is available for viewing on the following pages.

END OF DOCUMENT 003119

February 3, 2012

Mr. Stephen Atkinson, P.E.
Missouri Department of Conservation
PO Box 180
Jefferson City, MO 65102-0180

RE: Shepherd of the Hills Fish Hatchery, Taney County, MO

Dear Mr. Atkinson:

On January 18, 2012 a geologist with Palmerton & Parrish, Inc. observed soils in two test pits at the above referenced facility. The test pits were dug where a proposed septic lateral field is to serve part of the facility. Figure 1 shows the approximate location of the test pits on a site plan provided to us by the Missouri Department of Conservation (MDC). The test pits were in an area of 2%-3% slope that has been previously covered with pine trees and various types of undergrowth. Soils at the site are located on a small ridge top between the White River and a small tributary. Two soil borings drilled near the test pit locations during a subsurface investigation performed in July of 2010 indicate that the depth to bedrock in this area may exceed 10 feet. Soil samples were collected from each soil horizon and put through a #10 sieve (2 mm) to determine gravel content. The material passing the #10 sieve was classified using visual and manual methods.

According to the *Soil Survey of Taney County, Missouri* (1996) published by the U.S. Department of Agriculture, one soil type is dominant in the site area; the Ocic-Gatewood complex, 3 to 9 percent slopes, symbol 24C. These soils are typically gently sloping and moderately sloping, moderately well drained, and found on the ridge tops and foot slopes in the uplands. Ocic soils are deep and Gatewood soils are moderately deep. These soils are suitable for onsite waste disposal systems if the permeability and depth to bedrock are favourable.

The following tables summarize our observations in the two test pits.

North Test Pit		
Depth	Soil Description	Soil Horizon
0-1.5'	Brown (10YR 6/3) very gravelly silt loam (approx. 60% gravel), moist, some roots, very friable, weak fine granular structure	E
1.5'-2'	Reddish brown (2.5YR 4/4) very gravelly silty clay loam (approx. 85% gravel), moist, slightly plastic, moderate fine angular blocky structure	Bt
2'-2.3'	Red (2.5YR 3/6) very gravelly clay (approx. 80% gravel), moist, plastic, moderate fine angular blocky structure	C

South Test Pit		
Depth	Soil	Soil Horizon
0-0.8'	Dark brown (10YR 3/3) gravelly silt loam (approx. 35% gravel), moist, some roots and organic matter (leaves, pine needles), very friable, weak fine granular structure	A
0.8'-2.5'	Brown (10YR 6/3) very gravelly silt loam (approx. 60% gravel), moist, some roots, very friable, weak fine granular structure	E

Because of the gravel content, all of the soils observed in the test pits are typically classified in soil group 5 with regard to texture. The amount of rock fragments in these soils can be of concern in areas where residual soils immediately overly highly permeable bedrock. In general, soils with less than 50% rock fragments will be considered suitable and soils with more than 50% rock fragments over highly permeable bedrock is considered unsuitable. Soils with more than 50% rock fragments over low permeability bedrock are considered provisionally suitable. The wastewater application rates for soils in group 5 are typically 0.4 to 0.6 gallons per day per square foot (GPD/Sq. Ft.).

Because of the chert content in the clay soil observed in the north test pit, this C horizon soil likely has sufficient permeability to not be considered a fragipan. A seasonal high water table is not expected in these soils.

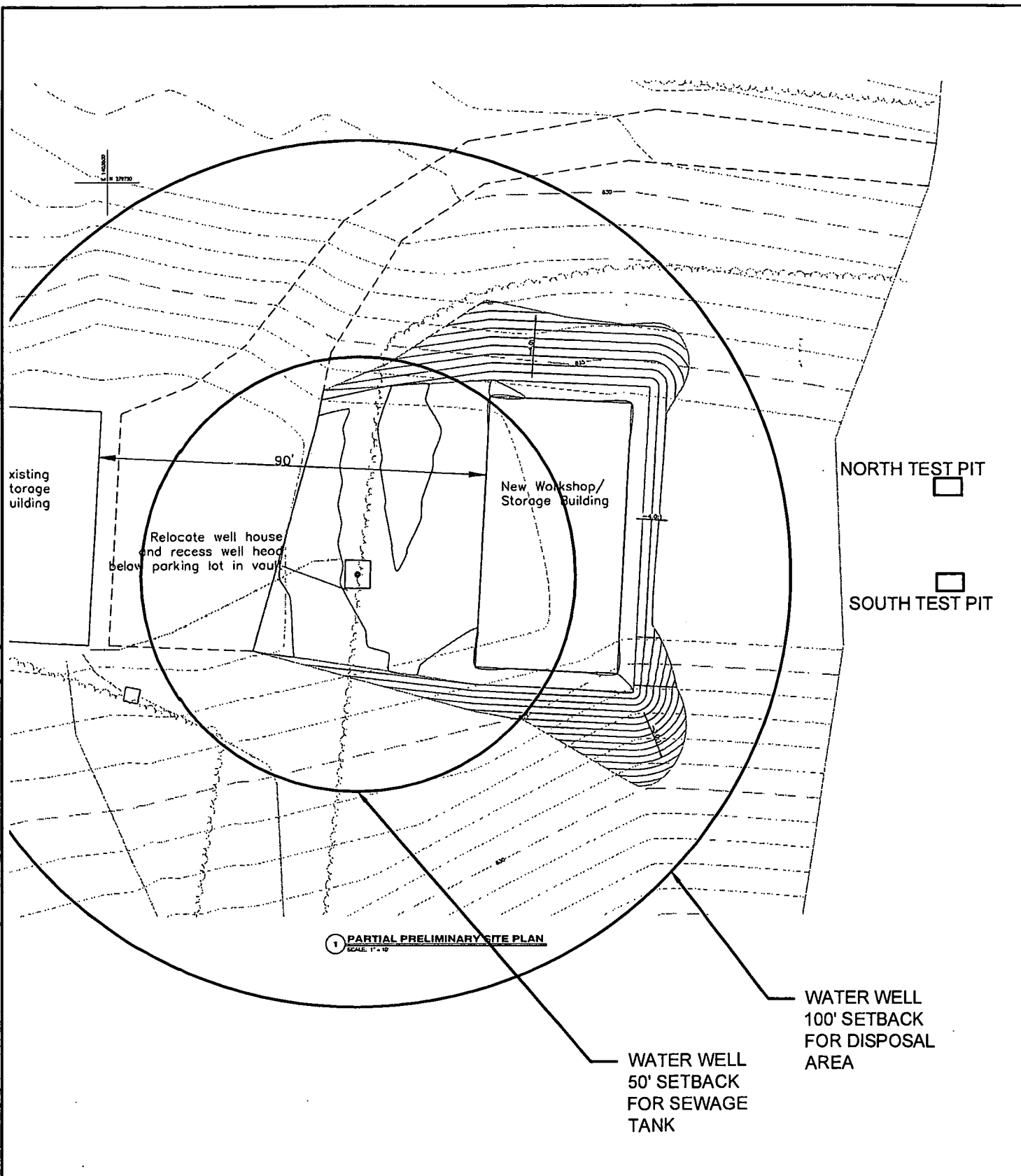
Should you have any questions or need additional information please do not hesitate to contact me at (417) 864-6000 or dnowack@ppimo.com.

PALMERTON & PARRISH, INC.

By:



Donald C. Nowack, P.E., R.G.



LEGEND

□ Test Pit Location

SCALE
1" = 30'

Project: Shepherd of the Hills Fish Hatchery, Taney County, Missouri
Client: Missouri Department of Conservation

Test Pit Locations

DATE: February 3, 2012

Project Number: 207156



PALMERTON & PARRISH, INC.
GEOTECHNICAL, CIVIL, AND MATERIALS ENGINEERS / MATERIALS TESTING LABORATORIES / ENVIRONMENTAL SERVICES

FIGURE 1

DOCUMENT 003126 – EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Contract. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions..
- B. An existing asbestos report for the project Bunk House Building, prepared by Sunbelt Environmental Services, Inc., dated December 20, 2011, is available for viewing on the following pages.

END OF DOCUMENT 003132



December 20, 2011

Kenny Poore
Missouri Department of Natural Resources
P.O. Box 180
Jefferson City, Mo. 65102-0180

RE: Asbestos Inspection at Sheppard of the Hills Trout Hatchery, Bunk House Building

Dear Mr. Kenny Poore:

On December 9, 2011 Sunbelt provided asbestos inspection services at the above-referenced location. The building was inspected for suspect asbestos-containing materials (ACM), to visually identify readily accessible suspect ACM, collect bulk samples, and provide laboratory analysis for asbestos content determination. Sample locations and estimated material quantities were documented for bulk samples collected from suspect materials. The purpose of the inspection was to determine the location of ACM so that it may be removed prior to remodeling of the structure.

ACM is defined as any material that contains more than one percent asbestos. ACM is then classified as either a friable ACM (material that can be crumbled, pulverized, or reduced to powder by hand pressure) or a non-friable material. Non-friable may further be defined as a Category I (packings, gaskets, resilient floor covering, and asphalt roofing products), or Category II (other material excluding Category I).

A total of 11 suspect materials were identified, sampled, and analyzed for asbestos content from the building. There were three samples positive for asbestos. These samples were from the 9x9 floor tiles and mastic, and the popcorn ceiling in the hallway from the kitchen. None of the other suspect materials were positive for asbestos.

A summary table of each building inspected is presented on the following page, outlining material descriptions, locations, and analytical results. Copies of the laboratory reports and descriptions of the sample locations are also attached. Should any areas be uncovered during the renovation or demolition that shows evidence of asbestos materials, additional sampling may be required.

If you have any questions please contact me.
Sincerely,

Leroy L. Schaefer, CEO
Missouri Asbestos Inspector #7034062111MOIR8085

621 North Prince Lane
Springfield, MO
417-831-5052
Fax 417-831-6258
www.sunbeltenv.com

**EMSL Analytical, Inc.**

3029 S. Jefferson, Saint Louis, MO 63118

Phone: (314) 577-0160 Fax: (314) 776-3313 Email: saintlouislabs@emsl.com

Attn: **Leroy Schaefer**
Sunbelt Environmental Services, Inc.
621 North Prince Lane
Springfield, MO 65802

Customer ID: SUNB51
Customer PO: 23580
Received: 12/13/11 12:30 PM
EMSL Order: 391109513

Fax: (417) 831-6258 Phone: (417) 831-5052
Project: MDNR Shepherd of the Hills Hatchery A-10854 -
Bunkhouse.

EMSL Proj:
Analysis Date: 12/17/2011

**Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA
600/M4-82-020 Method(s) using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
TRDBH-01 391109513-0001		Various Fibrous Heterogeneous	85% Cellulose	15% Non-fibrous (other)	None Detected
TRDBH-02-Floor Tile 391109513-0002		Various Non-Fibrous Heterogeneous		91% Non-fibrous (other)	9% Chrysotile
TRDBH-02- Adhesive 391109513-0002A		Black Non-Fibrous Heterogeneous		91% Non-fibrous (other)	9% Chrysotile
TRDBH-03 391109513-0003		Various Non-Fibrous Heterogeneous	8% Cellulose 6% Glass	86% Non-fibrous (other)	None Detected
TRDBH-04-Flooring 391109513-0004		Various Non-Fibrous Heterogeneous	8% Cellulose 6% Glass 6% Synthetic	80% Non-fibrous (other)	None Detected
TRDBH-04- Adhesive 391109513-0004A		Tan Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected

Initial report from 12/17/2011 15:31:26

Analyst(s)

Sue Ferrario (11)

Jeff Siria, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision and uncertainty data available upon request.

Samples analyzed by EMSL Analytical, Inc. Saint Louis, MO NVLAP Lab Code 200742-0

**EMSL Analytical, Inc.**

3029 S. Jefferson, Saint Louis, MO 63118

Phone: (314) 577-0150 Fax: (314) 776-3313 Email: saintlouislab@emsl.com

Attn: **Leroy Schaefer**
Sunbelt Environmental Services, Inc.
621 North Prince Lane
Springfield, MO 65802

Fax: (417) 831-6258 Phone: (417) 831-5052
Project: **MDNR Shepherd of the Hills Hatchery A-10854 -**
Bunkhouse

Customer ID: **SUNB51**
Customer PO: **23580**
Received: **12/13/11 12:30 PM**
EMSL Order: **391109513**

EMSL Proj:
Analysis Date: **12/17/2011**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 and/or EPA 600/M4-82-020 Method(s) using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
TRDBH-05 391109513-0005		Cream Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
TRDBH-06 391109513-0006		Cream Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
TRDBH-07 391109513-0007		Cream Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
TRDBH-08 391109513-0008		Brown Non-Fibrous Heterogeneous		100% Non-fibrous (other)	None Detected
TRDBH-09 391109513-0009		White Non-Fibrous Heterogeneous		96% Non-fibrous (other)	4% Chrysotile

Initial report from 12/17/2011 15:31:26

Analyst(s)

Sue Ferraro (11)

Jeff Slria
Jeff Slria, Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Samples received in good condition unless otherwise noted. Estimated accuracy, precision, and uncertainty data available upon request.

Samples analyzed by EMSL Analytical, Inc. Saint Louis, MO NVLAP Lab Code 200742-0

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Contract. They provide information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions.
- B. Soil-boring data for Project, obtained by Schauer Group, LLC. dated July 29, 2015, is available for viewing on the following pages.
- C. Related Requirements:
 - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project Site and existing conditions.

END OF DOCUMENT 003132

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429 Rockyview Lane
Shell Knob, Missouri 65747
Email SchauerGroup76@gmail.com
Ph 417. 830.1150

July 29, 2015

Dake /Wells Architecture
134 Park Central Square, Suite 300
Springfield, MO 65806

**GEOTECHNICAL INVESTIGATION
SHEPHERD OF THE HILLS HATCHERY
NEW VISITORS NATURE CENTER
BRANSON, MISSOURI**

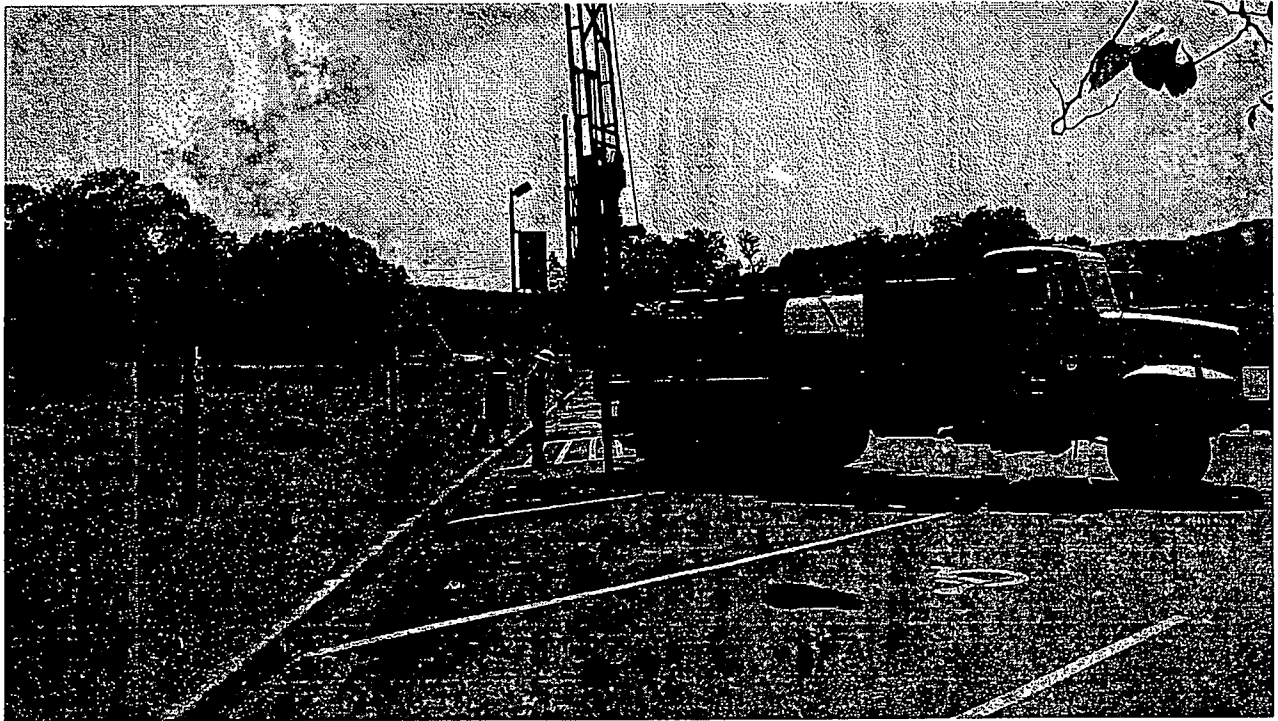
Gentlemen:

This report presents the results of a geotechnical investigation at the existing Shepherd of the Hills Trout Hatchery in Branson, Missouri. The purpose of this study was to identify the foundation conditions at the location of a new visitor's nature center and appurtenant constructions. This work was authorized by signing our proposal dated June 3, 2015.

INTRODUCTION

Scope of Work. The geotechnical investigation consisted of field and laboratory investigations followed by engineering analyses. The fieldwork included drilling 11 borings and performing field testing of the subgrade. Additionally, samples of the subgrade were returned from the field, where an Engineer inspected the samples and assigned appropriate laboratory tests. These tests were conducted to determine engineering properties of materials that would be used as basin linings or as foundation subgrade for structures. The results, conclusions, and engineering recommendations were then accumulated forming this report. More detailed descriptions of the work are detailed below.

2015-0010-01



Photograph 1. Truck-mounted CME 75 drill rig drilling Boring 3.

Proposed Construction. The area of the proposed construction is presently developed as part of the existing Shepherd of the Hills Hatchery by the Missouri Department of Conservation. The hatchery is located immediately downstream of Table Rock Dam where cold water discharge through the dam forms the tailwater lake, Lake Taneycomo. The plans show a new split-level visitors center with half the structure including a walk-out basement to the south. We understand the upper floor will have a finished floor elevation of 748 making the basement around El 738. A new water feature will include a pedestrian bridge, associated sidewalks and boardwalks, an outdoor education center, and changes to drives and parking lots. A bottom elevation of 733 is anticipated for the pond. Hatchery Road will have to be realigned to the north where the new building will encroach on the old roadway. Plate 1, in the back of this report, shows the project layout in plan view.

EXPLORATIONS and TESTING

Explorations. The field drilling work was performed on July 10, 2015 after clearing utilities through the Missouri One-call system and by coordinating with hatchery personnel familiar with on-site utility locations. An Engineer from Schauer Group was with the subcontracted driller during all field services providing quality control and establishing drilling protocols. Due to ease of access, we utilized a truck-mounted rotary drill rig. Holes were extended to depth using 4-inch OD flight augers. Sampling was performed using Standard Penetration Testing (SPT). We attempted retrieving several thin-walled stainless steel "Shelby" tubes, however due to gravel in the clay below grade, we were unsuccessful. Groundwater elevations were measured in the borings just before backfilling. In order to minimize the chance of someone stepping in an open borehole and being hurt, all borings were backfilled shortly after drilling.

The eleven borings (located on Plate 1) and denoted #1 through #11, were drilled to various depths depending on what structure was at that location and what final grade would be relative to existing grade. None of the borings encountered bedrock. Also shown on Plate 1 is the location of another boring drilled near the east end of the building in 2005. The logs of all borings are presented in Appendix A. This includes the old 2005 boring.

Laboratory Testing. Samples retrieved from the field were returned to the laboratory where they were tested for moisture content (ASTM D 4959) and USCS classification (ASTM D 2487 and D 4318). This data was then compiled and analyzed by the Engineer in making recommendations for such items as allowable bearing pressures and anticipated settlements, lateral earth pressures, determination of subgrade modulus, permeability and liner recommendations. The results of all laboratory tests can be seen on the boring logs.

SUBSURFACE CONDITIONS

Stratigraphy.

Road Re-alignment. The area of Borings #1 and #2, in the area of the new road alignment, shows stiff to very stiff clay but no bedrock down to 10 feet below grade. Boring #1 was about 5 feet above final road grade; Boring #2, a couple feet above final road grade. This indicates a stable subgrade and no rock excavation.

Building. Borings #4, #5, #6, #7, and the boring drilled in 2005 reveal stiff to very stiff clay with varying amounts of gravel. Borings #4 and #5 had a gravelly layer that carried water around El 735. Again, no bedrock was encountered within the depths of the holes which all extended below the bottom of the basement.

Parking Areas. Borings #3 and #6 show stiff to very stiff clay at elevations for subgrade to support pavements. No bedrock nor groundwater was encountered in the upper 10 feet below final grade.

Central Pond and Pedestrian Bridge/sidewalks. Borings #8, #9, and #10 show silty to fat clay at depths around the bottom of the new pond (El 733). A thin gravelly layer was encountered at about 5 feet in depth (El 736) in Boring #10. This stratum was saturated, undoubtedly being charged with water from the existing, adjacent pond. The soils were medium stiff to soft.

Bridge near Taneycomo. The single boring (#11) drilled near the east end of what will be a new pedestrian bridge displayed medium stiff to stiff clay in the upper 5 feet underlain with soft, saturated sandy silt or silty sand beneath. The soft silt is White River alluvium. The particle size indicates a slow water environment at the time of deposition. This area was probably flood plain, outside the main river channel. Again, no bedrock was encountered in the upper 15 feet.

Bedrock and Groundwater. Water was encountered in Borings #4, #5, and #10. Borings #3 and #4 may indicate actual groundwater elevation, but the water level should be assumed to vary with total or seasonal rainfall amounts. Water at 5 feet in depth in Boring #10 is associated with the level of the adjacent trout pond and should NOT be considered static groundwater elevation at that location. Boring #11, drilled only 70 feet north of Lake Taneycomo, displayed saturated silt low in the hole, but no free water filled the hole in the short period of time the hole was open before being backfilled. We would estimate water would have risen to about 9 feet had the hole been left open. Again, water levels change. The estimated depth of water in this boring is only an indicator of static levels and should not be relied upon as a long-term level.

Bedrock was not encountered within the depths explored in any of the borings drilled for this work.

DESIGN RECOMMENDATIONS

Site Suitability and Site Preparation. The subsurface conditions at the site make the site suitable for the considered constructions. As with any construction site, topsoil and organics should be stripped, and vegetation cleared from areas where buildings, ponds, and pavements will be constructed. Vegetation should be disposed of with approved methods and in accordance with local ordinance. Organics soils may be stockpiled for later surface treatment in areas to be planted.

Hatchery Road Re-alignment and New Parking. The area of the road realignment will require minor grading to meet existing grade to the west. Soils at depth indicate adequate bearing properties to support a new, unyielding pavement section. Areas where new parking and drives will be constructed are near final grade now. After stripping organics.

and topsoil, and before base rock is placed, all subgrade should be proofrolled. During this process, a fully loaded tandem axle dump truck is slowly driven over the grade with the Engineer watching the performance of the supporting soils. Any areas that yield, rut, or pump should be dealt with at the direction of the geotechnical engineer. Base rock may be placed atop approved subgrade and compacted to a minimum of 98% its maximum standard Proctor dry density as determined by ASTM D 698.

New Visitors Nature Center. We understand, the building will have a walkout basement under its eastern half with a finished floor elevation of 748 (basement slab elevation around 738). We assume maximum column loads of less than 75 kips. We recommend shallow foundations be designed for a net allowable bearing pressure of 2 ksf. Strip footings should measure no less than 18 inches in width and isolated pads no less than 2 feet square. All exterior footings should bear a minimum of 30 inches below adjacent exterior grade. Interior footings (placed in heated areas) may bear just beneath the floor slab. Total settlement of footings could approach an inch with differential movement assumed at half the total or one-half inch. This is generally within acceptable tolerances for most structures.

Due to the proximity of groundwater to the basement slab elevation we recommend a perimeter drain be installed around the entire outside periphery of the basement. Basement walls should be water-proofed. Generally, a granular backfill placed immediately adjacent to the wall with a filter wrapped slotted pipe at the bottom is the standard. The pipe should daylight by gravity to the south. Additionally, we recommend a sump pit be installed inside the perimeter basement wall, beneath the floor slab with a pump to remove water that might enter the rock beneath the basement floor. The sump pit should be hydraulically connected to the entire floor base rock.

Seismic/Transient Loadings. This area of Missouri is of the lowest potential for seismicity according to both the BOCA National Building Code and IBC. The upland clays encountered below grade in the building area are not considered likely to

amplify low frequency vibrations and would be expected to attenuate high frequencies.¹ According to IBC, this site would be a Site Class Category B with a weighted near-surface shear wave velocity computed between 3,000 and 4,000 fps. A peak long period acceleration coefficient of 2/3 of .1g or .07g and a short-period acceleration coefficient of 2/3 of 0.2g or 0.14g are given for Code-driven design. A Site coefficient of 1.0 would be indicated for this area.

Pedestrian Bridges. The upper 5 feet of grade, whether at the bridge near Taneycomo or higher, at the new pond, display adequate bearing characteristics. We recommend placing these foundations just below frost depth on small isolated pads. These pads should be designed for a net allowable bearing pressure of 2 ksf and should measure no less than 2 feet square in plan view.

Pond Lining. Except for some gravelly zones, the subgrade is essentially impermeable clay. We recommend over excavating the bottom and sides of the pond and water courses 12 inches, *rolling the subgrade*, then replacing the over-dig with two, 6-inch lifts of compacted clay. The clay should be compacted to 95 percent of its maximum dry density as determined by the standard Proctor test (ASTM D 698). The considerations for this recommendation is presented later under the heading **Basin Liner**. Sides of the pond may have to be thicker than the bottom just because of the way it will be constructed. For the sides to be water-tight, the sloping pond side should be brought up in 9-inch lifts but the sides should be a minimum of one compactor width wide (around 8 feet). This allows lifts to be placed level (while the face of the pond slopes) around the periphery of the pond. We recommend pond sides at no steeper than 2H:1V.

Excavation Work. The soils encountered below grade should be readily excavated with conventional earth moving equipment. In the area of the building and road/parking areas, we

¹ Boring 11, at the pedestrian bridge adjacent to Taneycomo, displays a subgrade that could amplify low frequency accelerations. We doubt this light bridge will be designed to Code, however.

would not anticipate any particular difficulties associated with soft subgrade. However, in the area of the pond, tracked vehicles will be preferable to using rubber wheeled vehicles with high tire pressures. Here, saturated subgrade may pump and lose strength with repeated traffic.

Basement Backfill. Generally, basement walls are not designed as retaining walls, but they should be. Steel should be included in the walls and the lateral pressures should be considered "at rest". For this site a lateral earth pressure coefficient of 0.5 is given. Assuming a damp unit weight of 120 pcf, an equivalent fluid pressure of 60 pcf is given for design. Care should be taken in compacting fills against walls, however. Small, light compaction equipment should be used. Unless the backfill is used to support structures, it should not be compacted above 90 percent its standard Proctor density. High compaction increases the lateral load on the wall and can crack basement walls.

Basin Liner. Permeability is the issue for the basins. The recommendations given previously will allow for a low amount of leakage from the pond. With a conservatively assumed permeability of 1.0×10^{-7} cm/sec, we note the following. The Missouri Department of Natural Resources - Code of State Regulations for sewage lagoons recommends a liner thickness computed from the following formula (assumes a transmission of no more than 500 gallons/day/acre):

$$T = (h)(k)/(5.4)(10^{-7})\text{cm/sec where}$$

T = liner thickness in feet

h = Head in pond in feet

k = permeability of liner (cm/sec).

What this formula states is that the ratio of the permeability of the liner to 5.4×10^{-7} cm/sec should be multiplied by the head on the liner. If we assume 5 feet of water in the pond, then 1/5 of 5 is one foot. Our limitation on leakage is probably much less stringent than 500 gal/ac/day assumed in the above equation, but we will consider it valid. The

recommendations given above are conservative, but not overly expensive to implement.

Utilities. Though we managed to miss drilling through any utility lines in this portion of the work, we recommend that utility lines be more accurately located on the property for future work. Some of the utility drawings we have reviewed have hand-scratched notes on them, and lines are shown where it was determined they could NOT exist. Obviously, for this project, any lines that happen to be within the construction area will either be damaged then repaired, or may remain in place, even if beneath new constructions. We recommend hiring a utility locating company to accurately locate lines for permanent records for the Hatchery.

Construction Observations. The soils Engineer and/or materials testing firm should be retained by the Owner or his Engineer to monitor the construction. The Contractor is not the best party to retain the testing firm. Compaction of fills, testing of concrete, proofrolling of subgrade, and general quality control of the earthwork is a relatively inexpensive insurance premium considering the risks of poorly constructed elements.

SUMMARY

The site is readily developable as planned. Allowable bearing for structures of 2,000 psf is applicable considering groundwater levels and soil moduli. The on-site soils should make adequate pond lining precluding the need for synthetic liners or expensive soil modification techniques. The existing subgrade is adequate, without modification, to support slabs on grade.

LIMITATIONS

The borings reveal data at the locations of the borings and information from areas between or adjacent to the borings is inferred. If, during the construction, conditions are observed that are

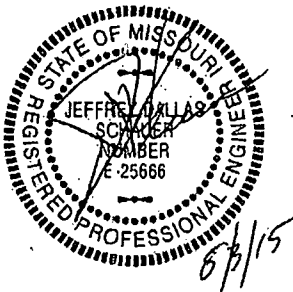
Dake Wells Architects
July 29, 2015
Page 10

Schauer Group

different than those described herein, we should be notified such that we can consider the new information. Additionally, on site inspections during construction is the best last chance to determine that the conditions realized in the field are as considered in generating the recommendations given above. The construction observations are best performed directly for the Owner, as it can be construed as a conflict of interests if the inspecting party works for the Contractor(s).

If you have any questions or comments, or need further work, please contact us.

Very truly yours,
SCHAUER GROUP, LLC

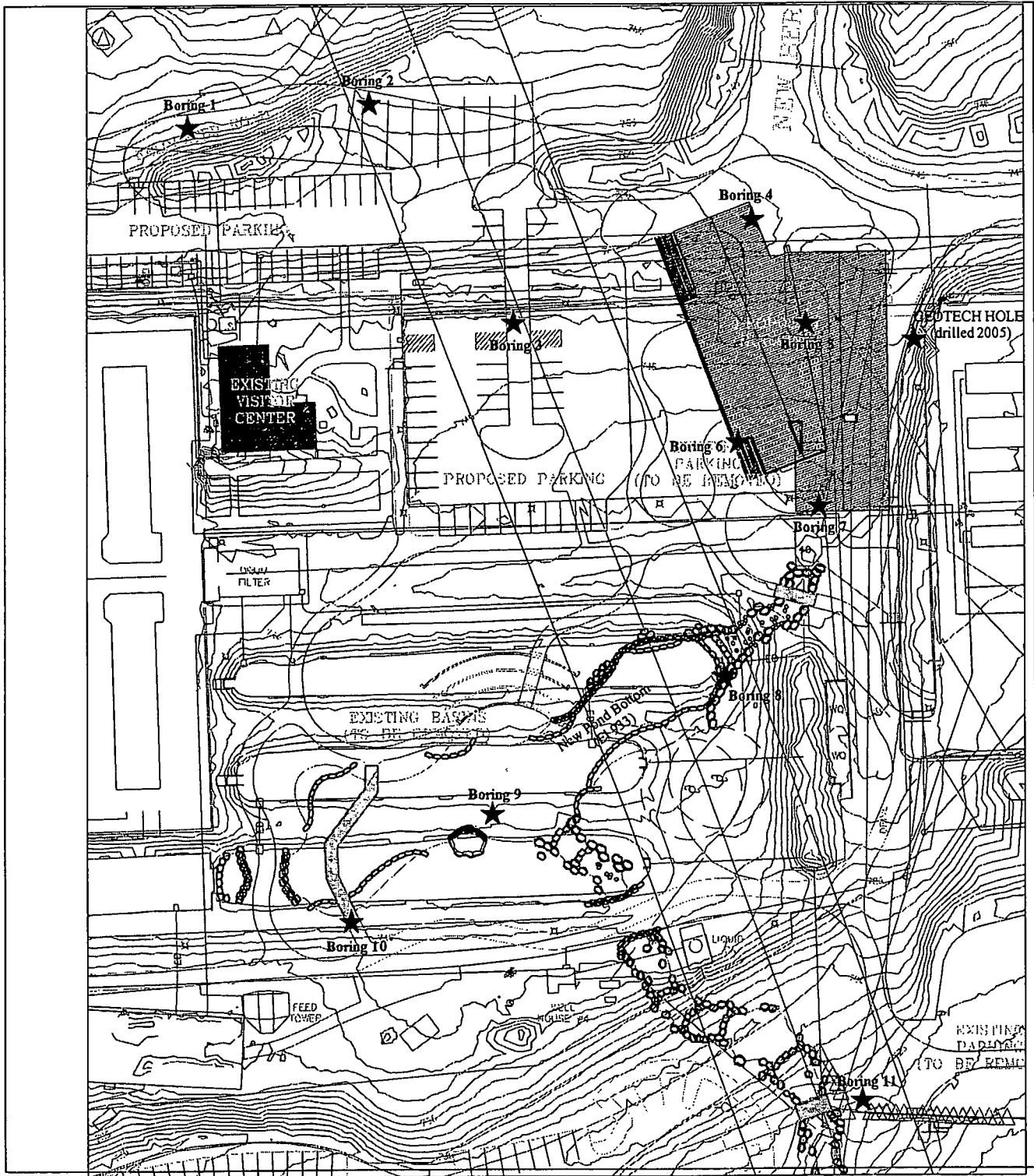


Jeff D. Schauer, P.E.
Engineer

Attachments: Plate 1: Site Plan with Borings
Appendix A: Boring Logs

APPENDIX A

Boring Logs



BORING LOCATION PLAN

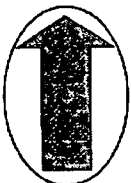
Dake / Wells Architects
 Shepherd of the Hills Hatchery
 New Visitors Nature Center
 Branson, Missouri

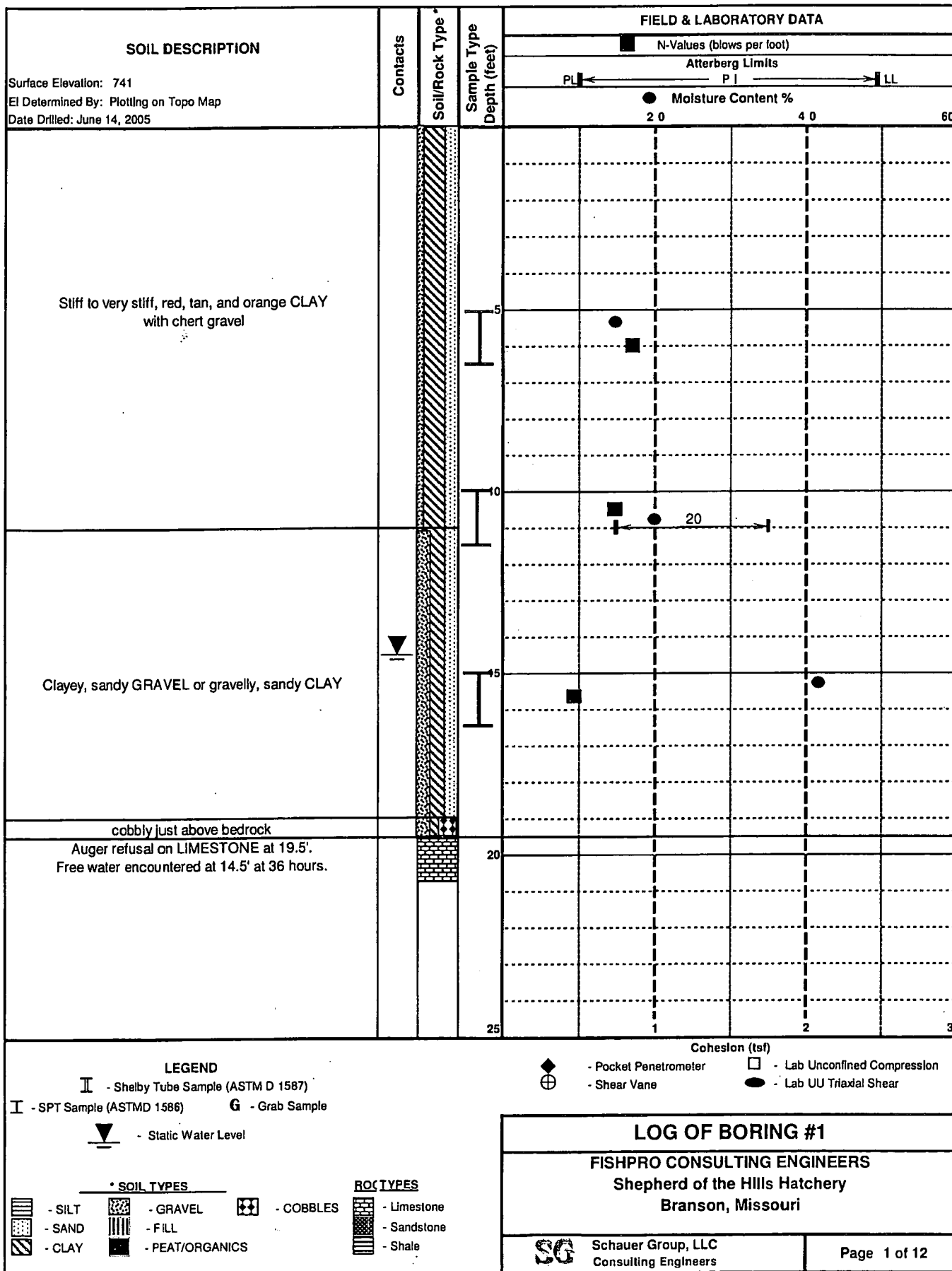


Schauer Group, LLC
 Consulting Engineers

PLATE 1

5
4
3
2
1
0
Z





SOIL DESCRIPTION	Contacts	Soil/Rock Type *	Depth (feet)	FIELD & LABORATORY DATA			
Surface Elevation: 759 Et Determined By: Topo. Map Date Drilled: July 10, 2015				■ N-Values (blows per foot) Atterberg Limits PL ← P I → LL			
				● Moisture Content %			
				20	40	60	
Stiff, brown to red, gravelly CLAY			3				
Very stiff, brown to buff, CLAY with trace sand			6				
No refusal. Hole terminated at 10 feet. No Free Ground Water Encountered.			9				
			12				

LEGEND

- Shelby Tube Sample (ASTM D 1587)
 - SPT Sample (ASTMD 1586) NR - Sample not recovered.
 - Static Water Level
 - Rock Core

* SOIL TYPES	ROCK	TYPES
- SILT - SAND - CLAY	- GRAVEL - COBBLES - FILL	- Limestone - Sandstone - Shale

Cohesion (tsf)

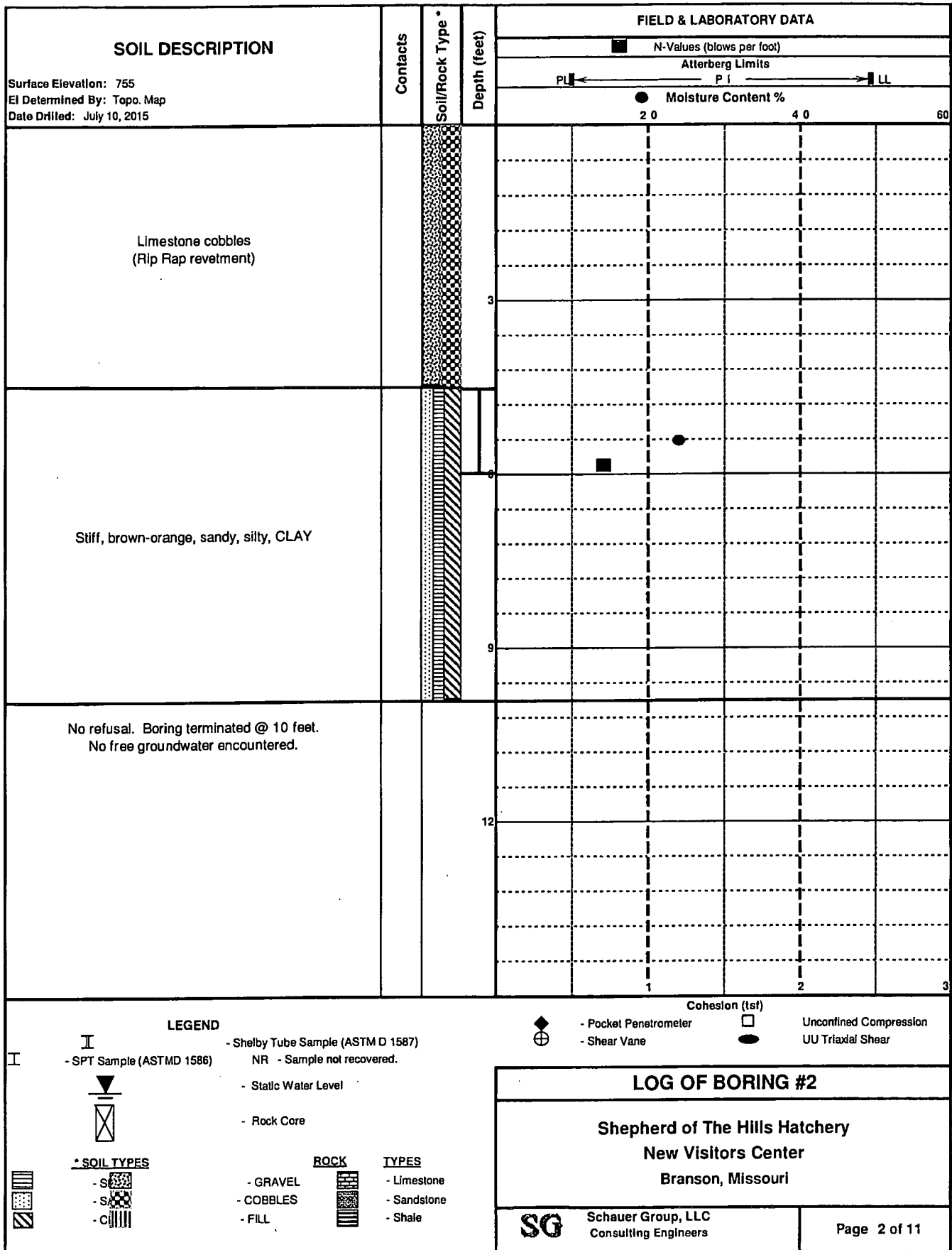
- Pocket Penetrometer - Lab Unconfined Compression
 - Shear Vane - Lab UU Triaxial Shear

LOG OF BORING #1

Shepherd of The Hills Hatchery
New Visitors Center
Branson, Missouri

Schauer Group, LLC
 Consulting Engineers

Page 1 of 11



SOIL DESCRIPTION		FIELD & LABORATORY DATA	
Surface Elevation: 746 El Determined By: Topo. Map Date Drilled: July 10, 2015		Contacts	Soil/Rock Type *
			Depth (feet)
		N-Values (blows per foot) Atterberg Limits PL ← P I → LL Moisture Content % 20 40 60	
Asphalt			
Base Rock.			
Stiff, orange-red, sandy CLAY			
Very stiff, red-brown, clayey GRAVEL			
No refusal. Boring terminated at 8.5 feet. No free groundwater encountered.			

LEGEND

- I - Shelby Tube Sample (ASTM D 1587)
- ⊥ - SPT Sample (ASTMD 1586) NR - Sample not recovered.
- ▽ - Static Water Level
- ⊗ - Rock Core

* SOIL TYPES

- SILT
- SAND
- CLAY
- GRAVEL
- COBBLES
- FILL

ROCK

- Limestone
- Asphalt
- Shale

TYPES

- Limestone
- Asphalt
- Shale

Cohesion (tsf)

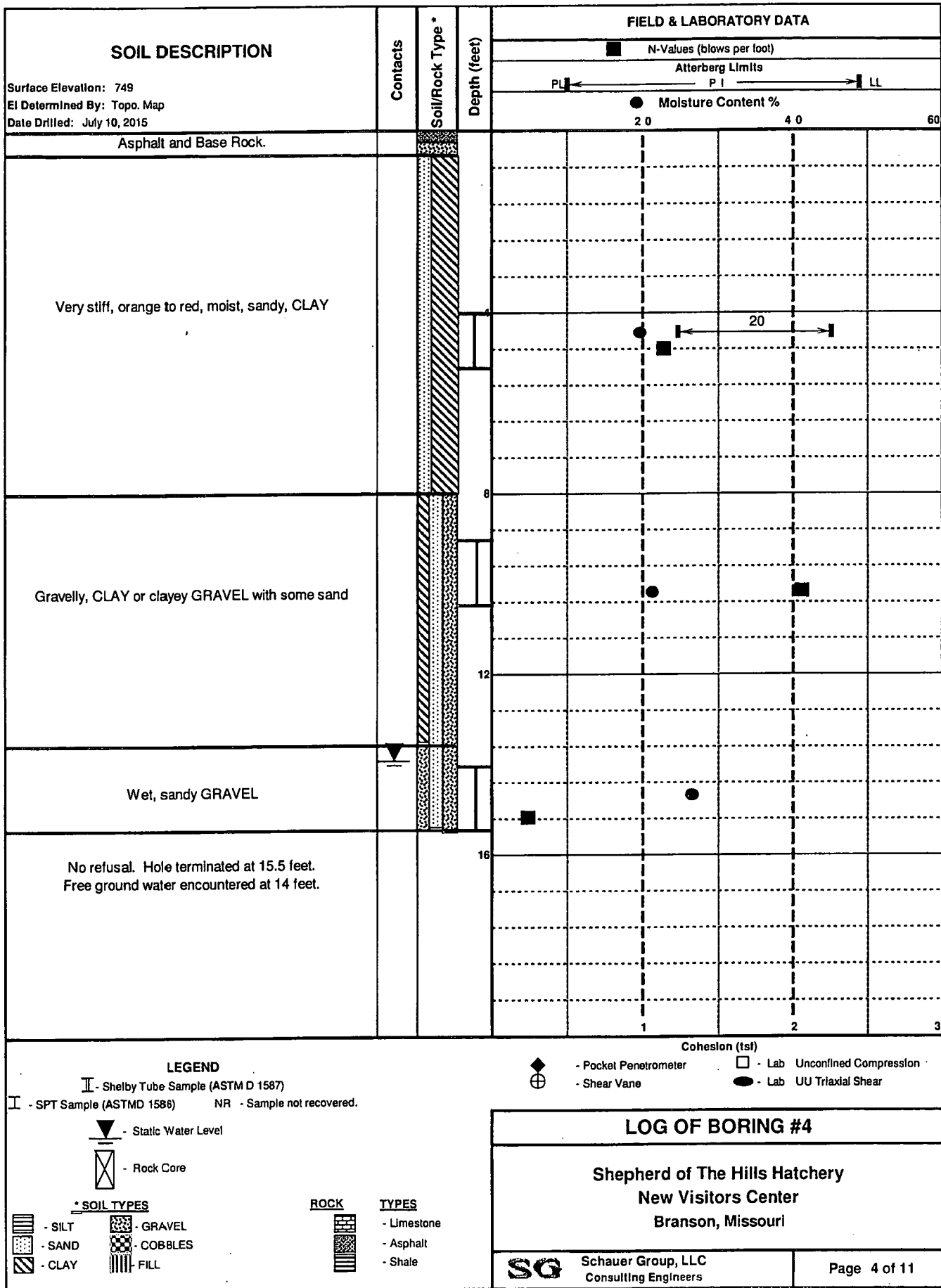
- ◆ - Pocket Penetrometer
- ⊕ - Shear Vane
- - Lab Unconfined Compression
- - Lab UU Triaxial Shear

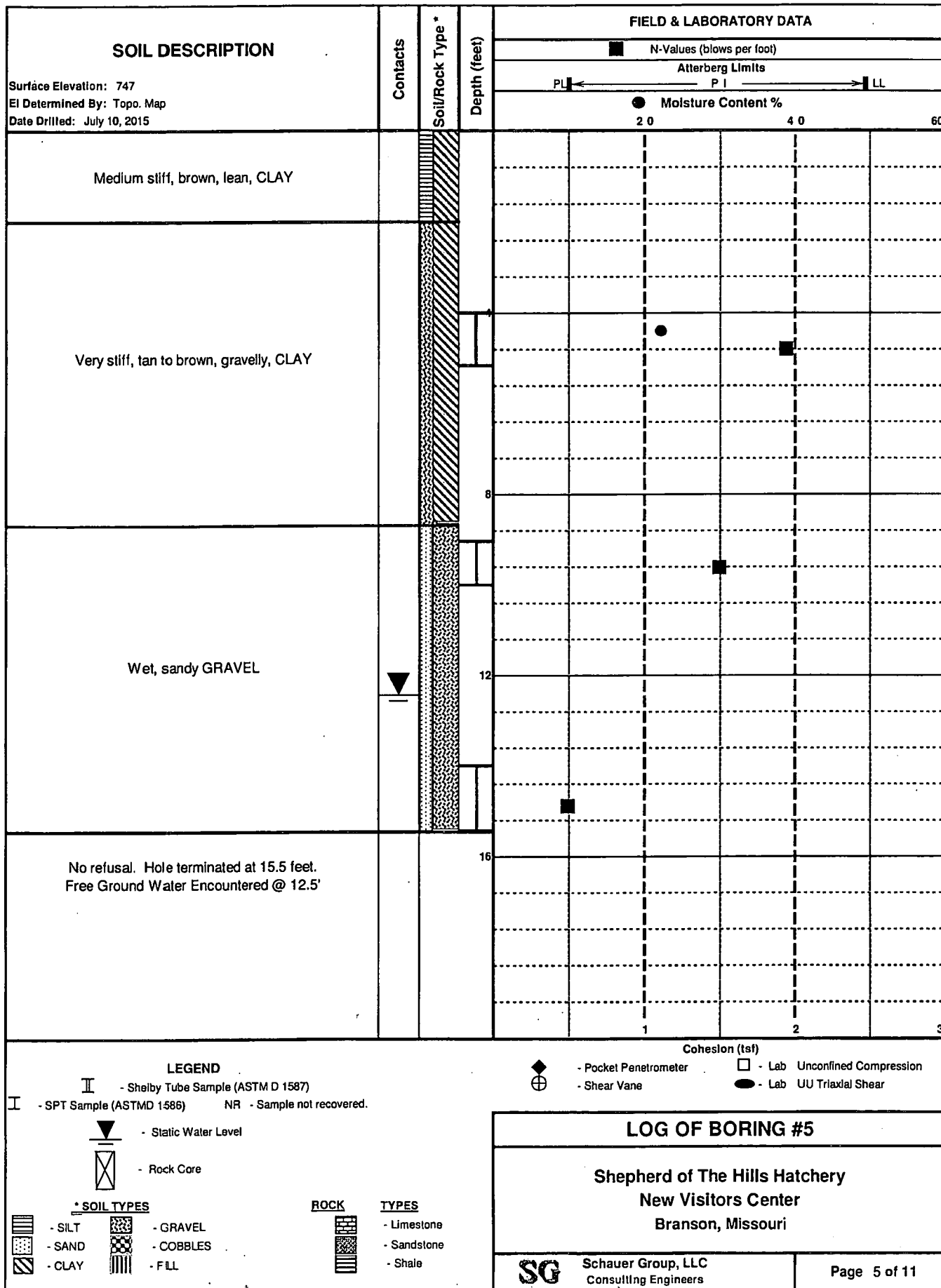
LOG OF BORING #3

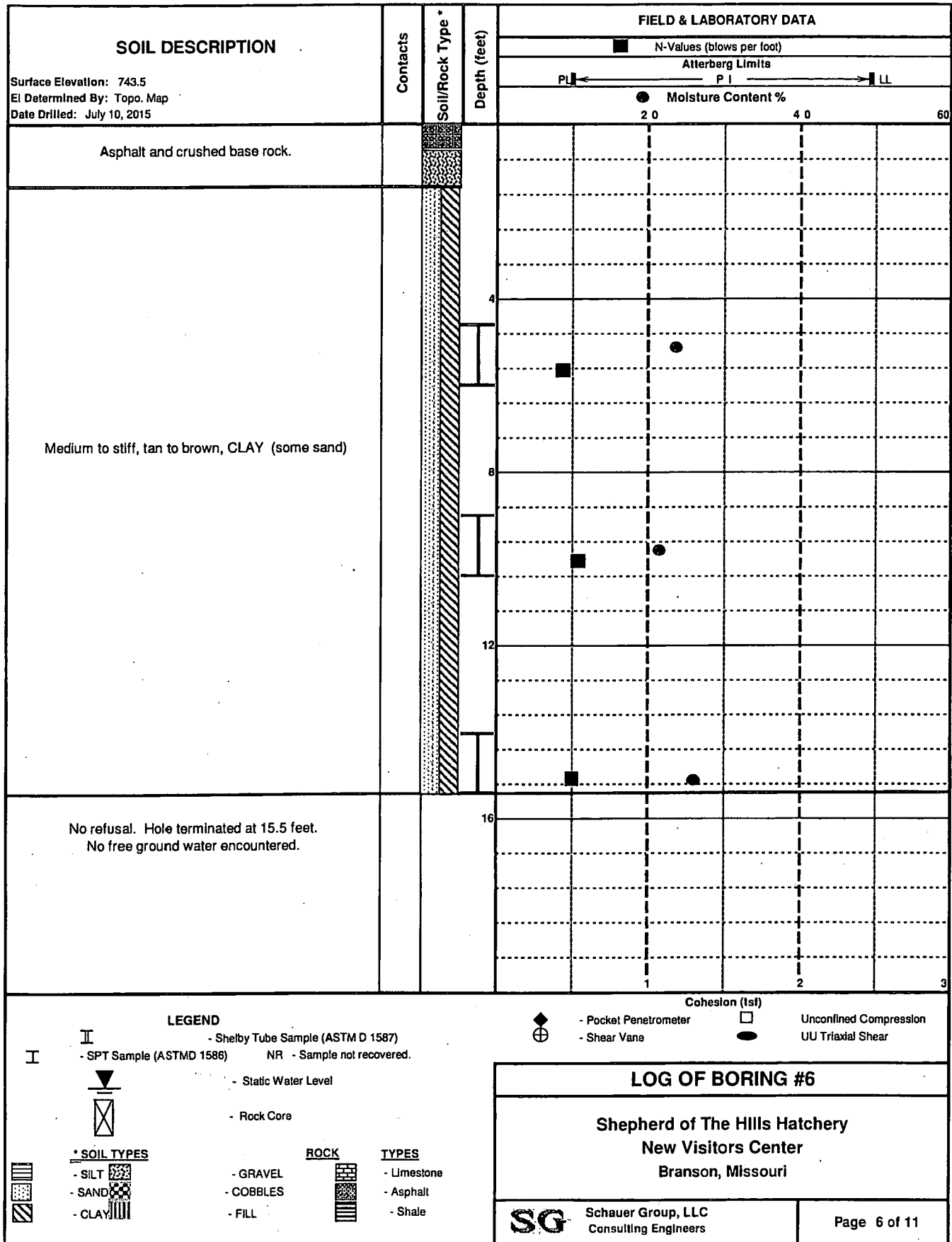
**Shepherd of The Hills Hatchery
New Visitors Center
Branson, Missouri**

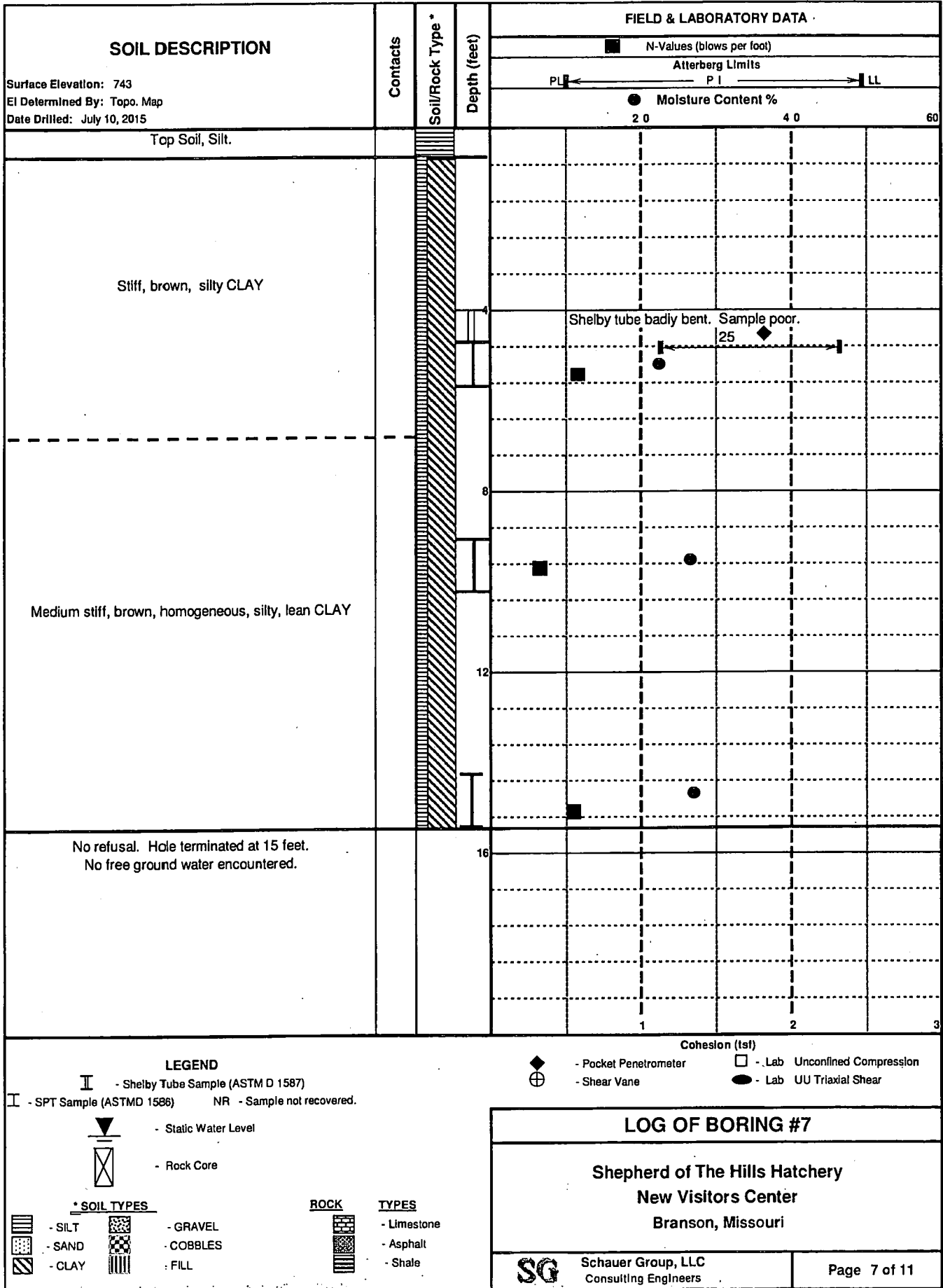
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 Consulting Engineers

Page 3 of 11









SOIL DESCRIPTION		Contacts	Soil/Rock Type *	Depth (feet)	FIELD & LABORATORY DATA			
					N-Values (blows per foot)	Atterberg Limits PL ← P I → LL		Molsture Content % 20 40 60
Surface Elevation: 743 El Determined By: Topo. Map Date Drilled: July 10, 2015								
Cobbly zone (2 to 3 feet)			[Pattern]					
Soft to very soft, brown lean CLAY trace fine sand			[Pattern]		0/12"			
Firmer.... Medium stiff			[Pattern]	8				
No refusal. Hole terminated at 10 feet. No Free Ground Water Encountered.				12				
				16				

LEGEND

- I - SPT Sample (ASTMD 1586)
- ▼ - Static Water Level
- X - Rock Core

*** SOIL TYPES**

- SILT [Pattern]
- SAND [Pattern]
- CLAY [Pattern]

ROCK TYPES

- GRAVEL [Pattern]
- COBBLES [Pattern]
- FILL [Pattern]
- Limestone [Pattern]
- Sandstone [Pattern]
- Shale [Pattern]

Cohesion (tsf)

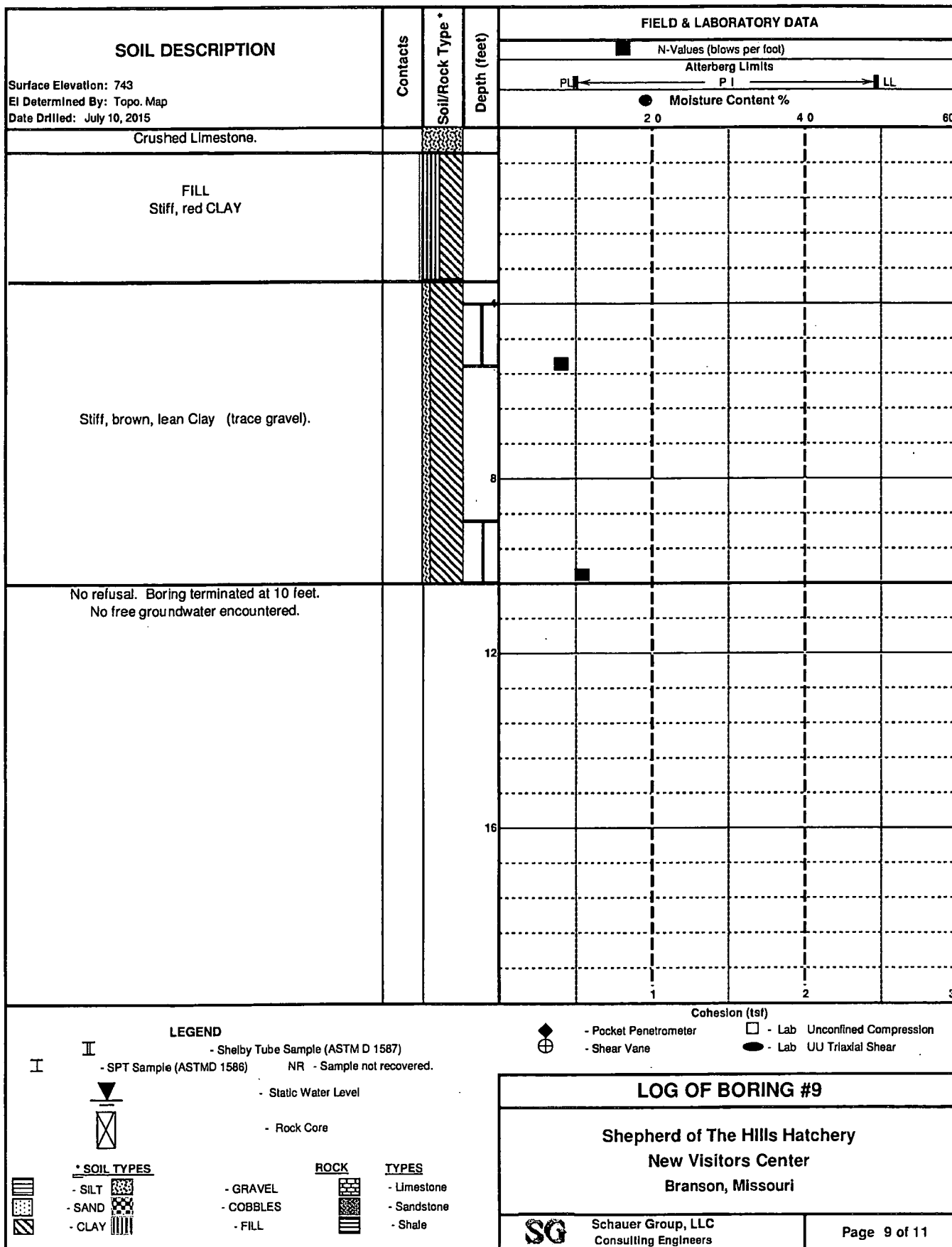
- Pocket Penetrometer [Symbol]
- Shear Vane [Symbol]
- Lab Unconfined Compression [Symbol]
- Lab UU Triaxial Shear [Symbol]

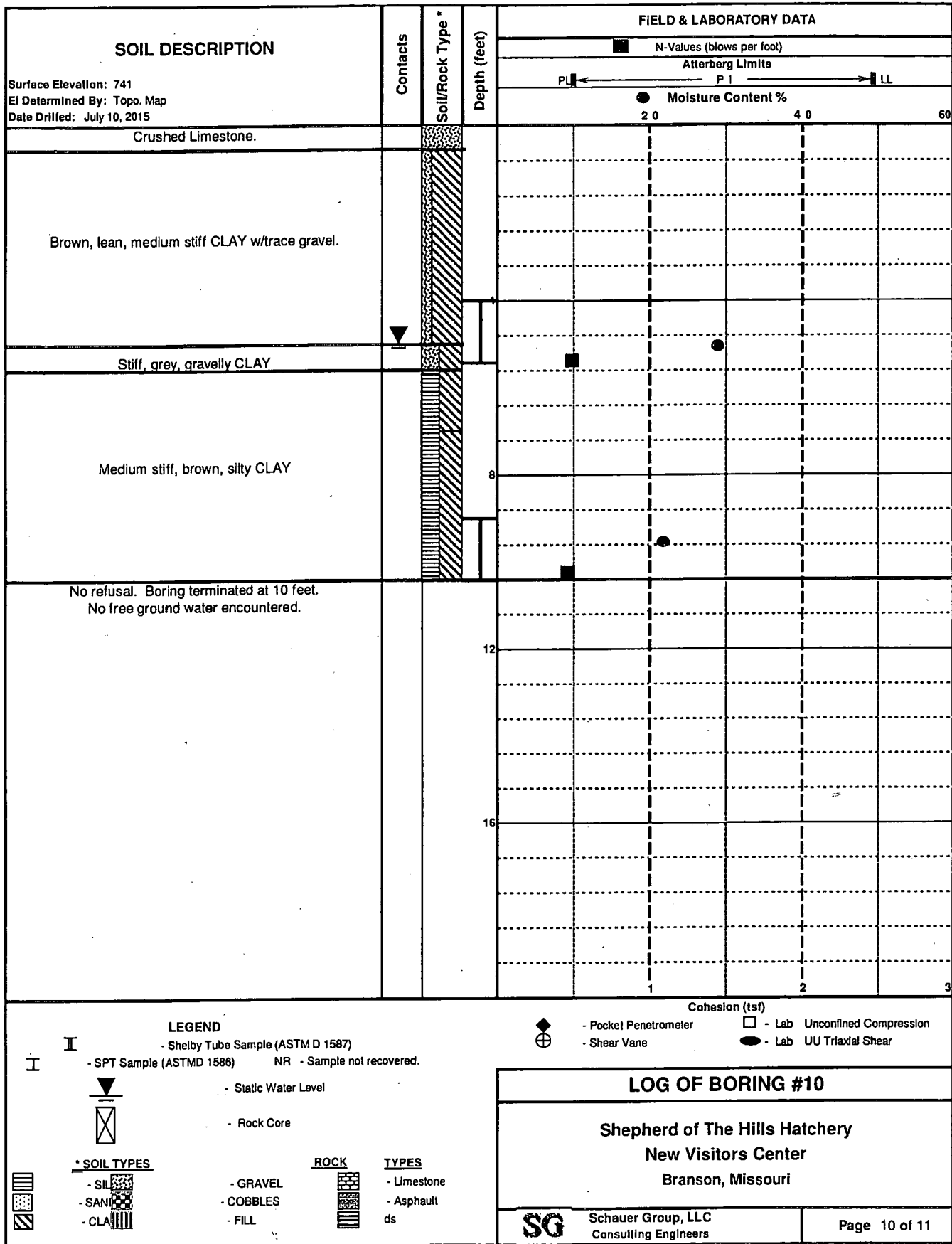
LOG OF BORING #8

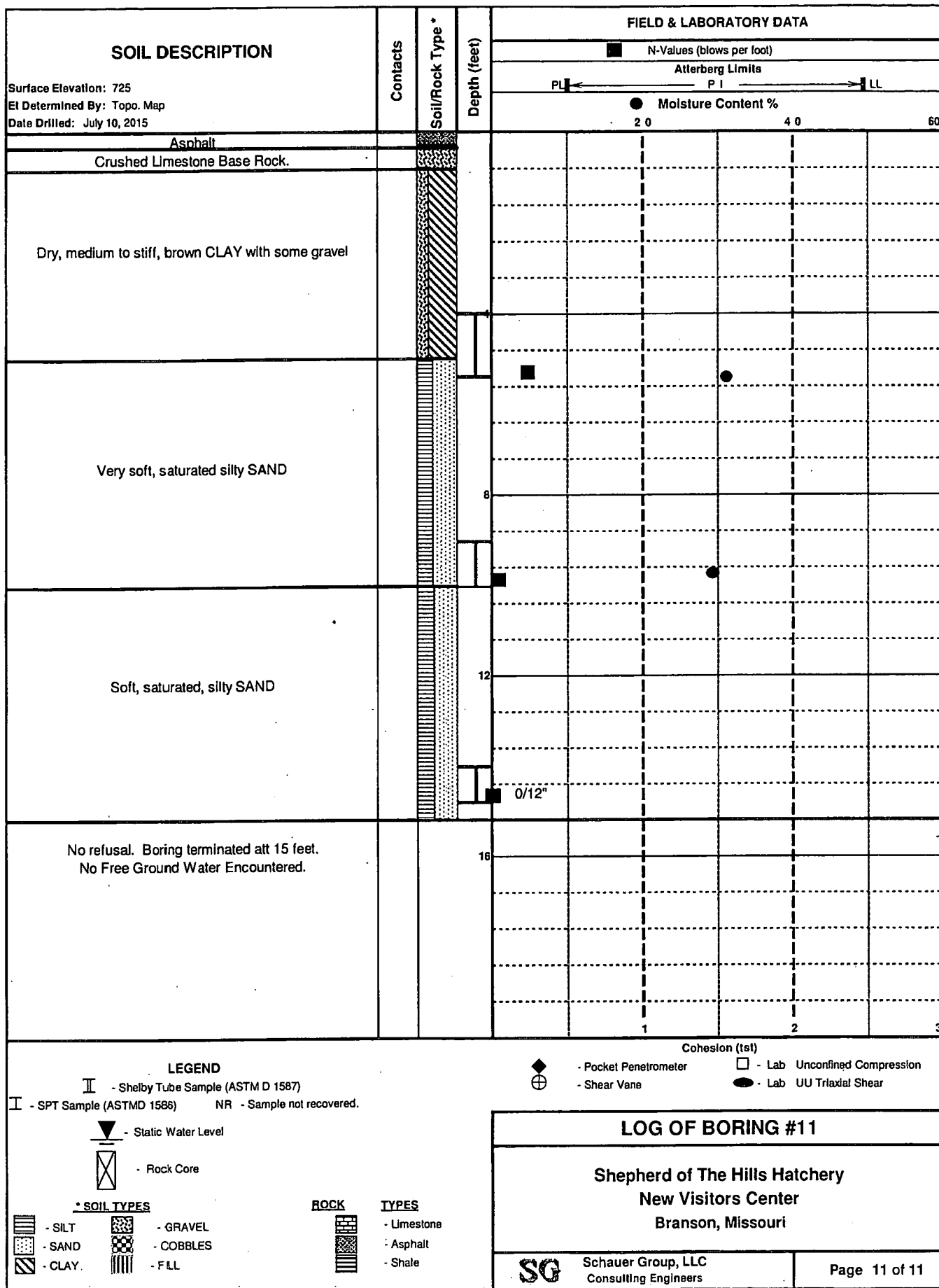
**Shepherd of The Hills Hatchery
New Visitors Center
Branson, Missouri**

Schauer Group, LLC
Consulting Engineers

Page 8 of 11







DOCUMENT 003143 – FLOODPLAIN DEVELOPMENT PERMIT(S)

1.1 PERMIT INFORMATION

- A. The contractor shall comply with all conditions of the following Permits, and their attachments, as well as other applicable federal, state and local permits throughout the entire contract period.
- B. This Project will require a permit from the City of Branson and the Missouri Department of Public Safety, Emergency Management Agency for floodplain development. The contractor shall obtain all necessary permits before any part of the work is performed on this Project.

END OF DOCUMENT 003143

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City of Branson
Planning and Development Department
110 W. Maddux St., Ste. 215
Branson, MO 65616
417-337-8549/Fax 417-334-2391

FLOODPLAIN DEVELOPMENT

City of Branson Municipal Code Chapter 38 - Environment

Purpose

To promote the public health, safety, and general welfare; to minimize those losses described in Chapter 38 of the Branson Municipal Codebook, and to maintain the community's eligibility to participate in the National Flood Insurance Program.

Floodplain Development Permit

No development within any numbered or unnumbered A zone or AE zones on the current FIRM maps dated March 15, 2012 may be initiated until an applicant obtains a Floodplain Development Permit (FDP) prior to any construction activity.

Development is defined as "any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, levees, levee systems, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials".

Note: Staff is available to assist you in answering questions 6, 7, 8, and 12 of your Floodplain Development Permit/Application. If your project is located in a wetland or stream, we will notify you if a 404, 401, and/or a NPDES permit may be required. If a permit(s) is required, please contact the following agencies:

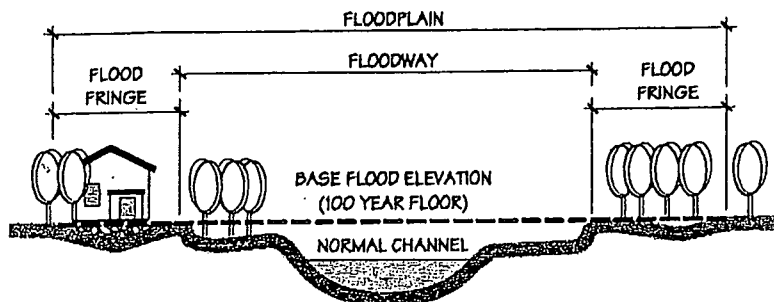
404 Permit – Corps of Engineers

- 501-324-5295
- Visit: <http://www.swl.usace.army.mil/>
- Click on the black button "Regulatory Permits"
- In the lower right hand corner of the screen, click the red box that says "CLICK TO FILL OUT A CORPS PERMIT"

401 Permit and NPDES Permit -Missouri Department of Natural Resources (DNR)

573-751-1300

<http://dnr.mo.gov/env/wpp/401/>



Cost that must be included in determining value of improvement/repair

Items that must be included in the value of improvement and the costs to repair are those that are directly associated with the building. The following list of costs that must be included is not intended to be exhaustive, but characterizes the types of costs that must be included:

- Materials and labor, including the estimated value of donated or discounted materials and owner or volunteer labor
- Site preparation related to the improvement or repair (e.g., foundation excavation or filling in basements)
- Demolition and construction debris disposal
- Labor and other costs associated with demolishing, moving, or altering building components to accommodate improvements, additions, and making repairs
- Costs associated with complying with any other regulations or code requirement that is triggered by the work, including costs to comply with the requirements of the Americans with Disabilities Act (ADA)
- Costs associated with elevating a structure when the proposed elevation is lower than the BFE
- Construction management and supervision
- Contractor's overhead and profit
- Sales taxes on materials
- Structural elements and exterior finishes, including:
 - Foundations (e.g., spread or continuous foundation footings, perimeter walls, chainwalls, pilings, columns, posts, etc.)
 - Monolithic or other types of concrete slabs
 - Bearing walls, tie beams, trusses
 - Joists, beams, subflooring, framing, ceilings
 - Interior non-bearing walls
 - Exterior finishes (e.g., brick, stucco, siding, painting, and trim)
 - Windows and exterior doors
 - Roofing, gutters, and downspouts
 - Hardware
 - Attached decks and porches
- Interior finish elements, including:
 - Floor finishes (e.g., hardwood, ceramic, vinyl, linoleum, stone, and wall-to-wall carpet over subflooring)
 - Bathroom tiling and fixtures
 - Wall finishes (e.g., drywall, paint, stucco, plaster, paneling, and marble)
 - Built-in cabinets (e.g., kitchen, utility, entertainment, storage, and bathroom)
 - Interior doors
 - Interior finish carpentry
 - Built-in bookcases and furniture
 - Hardware
 - Insulation
- Utility and service equipment, including:
 - Heating, ventilation, and air conditioning (HVAC) equipment
 - Plumbing fixtures and piping
 - Electrical wiring, outlets, and switches
 - Light fixtures and ceiling fans
 - Security systems
 - Built-in appliances
 - Central vacuum systems
 - Water filtration, conditioning, and recirculation systems

Costs that may be excluded from determining value of improvement/repair

Items that can be excluded are those that are not directly associated with the building. The following list characterizes the types of costs that may be excluded:

- Clean-up and trash removal
- Costs to temporarily stabilize a building so that it is safe to enter to evaluate and identify required repairs
- Costs to obtain or prepare plans and specifications
- Land survey costs
- Permit fees and inspection fees
- Carpeting and recarpeting installed over finished flooring such as wood or tiling
- Outside improvements, including landscaping, irrigation, sidewalks, driveways, fences, yard lights, swimming pools, pool enclosures, and detached accessory structures (e.g., garages, sheds, and gazebos)
- Costs required for the minimum necessary work to correct existing violations of health, safety, and sanitary codes
- Plug-in appliances such as washing machines, dryers, and stoves

PLEASE READ BELOW

If your structure meets any of the following criteria, your structure will be subject to compliance requirements for demolition or elevating your structure.

Nonconforming use. A structure, or the use of a structure or premises that was lawful before the passage of the city's floodplain ordinance, but which is not in conformity with the provisions of Chapter 38, may be continued subject to the following conditions:

- If such structure, use, or utility service is discontinued for twelve (12) consecutive months, any future use of the building shall conform to Chapter 38 of the City of Branson Municipal Code.
- If any nonconforming use or structure is destroyed by any means, including flood, it shall not be reconstructed if the cost is more than 50 percent of the pre-damaged market value of the structure.

Cumulative improvement. A use or structure may be improved (remodeled or enlarged) without conforming to current requirements for elevation so long as the cumulative value of all work done within the last five calendar years does not exceed 50 percent of the structure's current market value. If the cumulative value of the improvement exceeds 50 percent of the structure's current market value, the structure must be brought into compliance which requires elevation of residential structure to or above the base flood elevation or the elevation/flood proofing of non-residential structures to or above the base flood elevation.

Substantial damage. Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. The term "substantial damage" includes repetitive loss. Repetitive loss means flood-related damages sustained by a structure on two separate occasions during a ten-year period for which the cost of repairs at the time of each such flood event, equals or exceeds 25 percent of the market value of the structure before the damage occurred.

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FLOODPLAIN DEVELOPMENT PERMIT/APPLICATION

Application No. _____

Date: _____

TO THE ADMINISTRATOR: The undersigned hereby makes application for a permit to develop in a floodplain. The work to be performed, including flood protection works, is as described below and in attachments hereto. The undersigned agrees that all such work shall be in accordance with the requirements of the Floodplain Management Ordinance and with all other applicable county/city ordinances, federal programs, and the laws and regulations of the State of Missouri.

Missouri Department of Conservation

Owner or Agent

Date

Builder

Date

Address

Address

Phone

Phone

SITE DATA

1. Location: _____ 1/4; _____ 1/4; Section _____; Township _____; Range _____
Street Address _____
2. Type of Development: Filling _____ Grading _____ Excavation _____ Minimum Improvement _____
Routine Maintenance _____ Substantial Improvement _____ New Construction _____ Other _____
3. Description of Development: _____
4. Premises: Structure Size _____ ft. By _____ ft. Area of Site _____ Sq Ft
Principal Use _____ Accessory Uses (storage, parking, etc.) _____
5. Value of Improvement (fair market) \$ _____ Pre-Improvement/Assessed Value of Structure \$ _____
6. Property Located in a Designated FLOODWAY? Yes ☐ No ☐

IF ANSWERED YES, CERTIFICATION MUST BE PROVIDED PRIOR TO THE ISSUANCE OF A PERMIT TO DEVELOP, THAT THE PROPOSED DEVELOPMENT WILL RESULT IN NO INCREASE IN THE BASE (100-YEAR) FLOOD ELEVATIONS.

7. Property Located in a Designated Floodplain FRINGE? Yes ☐ No ☐
8. Elevation of the 100-Year Flood (1D source) _____ MSL/NGVD
9. Elevation of the Proposed Development Site _____ MSL/NGVD
10. Local Ordinance Elevation/Floodproofing Requirement Branson Municipal Code Chapters 18 & 38 _____ MSL/NGVD
11. Other Floodplain Elevation Information (1D and describe source) N/A _____
12. Other Permits Required?

Corps of Engineer 404 Permit:	Yes _____	No _____	Provided _____
State Department of Natural Resources 401 Permit:	Yes _____	No _____	Provided _____
Environmental Protection Agency NPDES Permit:	Yes _____	No _____	Provided _____

All Provisions of Ordinance Number 2012-0032, the "Floodplain Management Ordinance", shall be in Compliance.

PERMIT APPROVAL/DENIAL

Plans and Specifications Approved/Denied this _____ Day of _____, 20____

Signature of Developer/Owner

Authorizing Official

Print Name and Title

Print Name and Title

THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT FLOOR) OF ANY NEW OR SUBSTANTIALLY IMPROVED RESIDENTIAL BUILDING WILL BE ELEVATED 1 FOOT/FEET ABOVE THE BASE FLOOD ELEVATION. IF THE PROPOSED DEVELOPMENT IS A NON-RESIDENTIAL BUILDING, THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT) OF A NEW OR SUBSTANTIALLY IMPROVED NON-RESIDENTIAL BUILDING WILL BE ELEVATED OR FLOODPROOFED 1 FOOT/FEET ABOVE THE BASE FLOOD ELEVATION.

THIS PERMIT IS USED WITH THE CONDITION THAT THE DEVELOPER/OWNER WILL PROVIDE CERTIFICATION BY A REGISTERED ENGINEER, ARCHITECT, OR LAND SURVEYOR OF THE "AS-BUILT" LOWEST FLOOR (INCLUDING BASEMENT) ELEVATION OF ANY NEW OR SUBSTANTIALLY IMPROVED BUILDING COVERED BY THIS PERMIT.

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Jeremiah W. (Jay) Nixon
Governor

Lane Roberts
Director of Public Safety

STATE OF MISSOURI

EMERGENCY MANAGEMENT AGENCY

Ron Walker
Director



DEPARTMENT OF PUBLIC SAFETY
PO Box 116, Jefferson City, Missouri 65102
Phone: 573/526-9100 Fax: 573/634-7966
E-mail: mosema@scma.dps.mo.gov



January 27, 2016

Robert Ziehmer
Director
Missouri Department of Conservation
PO Box 180
Jefferson City, Missouri 65102

Dear Director Ziehmer:

For several years, the Missouri State Emergency Management Agency (SEMA) and the Missouri Department of Conservation (MDC) have worked together under a Memorandum of Understanding (MOU) that was designed to provide MDC with flexibility to function rapidly during emergency situations in floodplain areas, while still complying with the Governor's Executive Order 98-03. The MOU ends with the statement:

"Be it further agreed that this Memorandum of Understanding shall be in effect for a minimum five (5) years from the date of the last signature affixed hereto. This Memorandum of Understanding may be amended only by the mutual written Understanding of both parties. This Memorandum of Understanding will automatically be extended upon the completion of the initial five-year period for an additional five-year period unless either party provides a written request for an amendment."

SEMA anticipates updating the current MOU, signed by John Hoskins, Director of the Department of Conservation on January 1, 2003, to more clearly address floodplain permitting concerns, while enabling Missouri to continue its participation in the National Flood Insurance Program (NFIP). This program provides some \$4 billion in policy coverage to citizens statewide. Once a draft is completed, SEMA will provide a copy to MDC for comments and suggestions before offering it for signature. In order to create a realistic timeframe for these actions, SEMA requests a two year extension of the current MOU.

If you have any questions, please feel free to contact Dale Schmutzler, State NFIP Coordinator at 573-526-9135.

Sincerely,

Ron Walker
Director

RB:klm



A Nationally
Accredited
Agency

Jeremiah W. (Jay) Nixon
Governor

Jerry Lee
Director of Public Safety



STATE OF MISSOURI

EMERGENCY MANAGEMENT AGENCY

Timothy A. Diemler
Acting Director

DEPARTMENT OF PUBLIC SAFETY
PO Box 116, Jefferson City, Missouri 65102
Phone: 573/526-9100 Fax: 573/634-7966
E-mail: mosema@sema.dps.mo.gov



December 18, 2013

COPY

Robert Ziehmer
Director
Missouri Department of Conservation
2901 W. Truman Blvd.
Jefferson City, MO 65102

Dear Director Ziehmer:

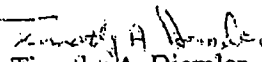
For several years, the Missouri State Emergency Management Agency (SEMA) and the Missouri Department of Conservation (MDC) have worked together under a Memorandum of Agreement (MOA) that was designed to provide MDC with flexibility to function rapidly during emergency situations in floodplain areas, while still complying with the Governor's Executive Order 98-03. The MOA ends with the statement:

"Be it further agreed that this Memorandum of Agreement shall be in effect for a minimum of five (5) years from the date of the last signature affixed hereto. This MOA may be amended only by the mutual written agreement of both parties. Otherwise, this MOA will automatically be extended upon the completion of the initial five-year period for an additional five-year period unless either party objects to the extension in writing."

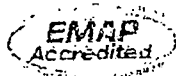
Last year SEMA requested a one year extension to determine whether the MOA needed updating. Upon further review, no updating is requested at this time. Therefore, SEMA requests a two year extension of the current MOA.

~~If you have any questions, please feel free to contact Dale Schmutzler, State NFIP Coordinator at 573-526-9135.~~

Sincerely,


Timothy A. Diemler
Acting Director

DS:tss



A Nationally
Accredited
Agency

Jeremiah W. (Jay) Nixon
Governor

Jerry Lee
Director of Public Safety

STATE OF MISSOURI

EMERGENCY MANAGEMENT AGENCY

Donald L. King
Director



DEPARTMENT OF PUBLIC SAFETY
PO Box 116, Jefferson City, Missouri 65102
Phone: 573/526-9100 Fax: 573/634-7966
E-mail: mosema@sema.dps.mo.gov



December 17, 2012

Robert Ziehmer
Director
Missouri Department of Conservation
2901 W Truman Blvd
Jefferson City, MO 65102

Dear Director Ziehmer:

For several years, the Missouri State Emergency Management Agency (SEMA) and the Missouri Department of Conservation (MDC) have worked together under a Memorandum of Agreement (MOA) that was designed to provide MDC with flexibility to function rapidly during emergency situations in floodplain areas, while still complying with the Governor's Executive Order 98-03. The MOA ends with the statement:

"Be it further agreed that this Memorandum of Agreement shall be in effect for a minimum of five (5) years from the date of the last signature affixed hereto. This MOA may be amended only by the mutual written agreement of both parties. Otherwise, this MOA will automatically be extended upon the completion of the initial five-year period for an additional five-year period unless either party objects to the extension in writing."

During the last several months, SEMA has been working to update the MOA to more clearly address floodplain permitting concerns, while enabling Missouri to continue participation in the National Flood Insurance Program (NFIP) that provides some \$5 billion in policy coverage statewide. Once the draft is completed, SEMA will staff it with MDC for comments and suggestions before offering it for signature. For this reason, SEMA prefers to extend the current MOA for one year only at this time. We hope you will agree.

If you have any questions, please feel free to contact Mr. Randy Scrivner, State NFIP Coordinator at 573-526-9141.

Sincerely,

Donald L. King
Donald L. King
Director

SRS:srs



A Nationally
Accredited
Agency



MISSOURI DEPARTMENT OF CONSERVATION

Headquarters

2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573-751-4115 ▲ Missouri Relay Center: 1-800-735-2966 (TDD)

JOHN D. HOSKINS, Director

January 7, 2003

Mr. George Riedel
State of Missouri Emergency Management Agency
P.O. Box 116
Jefferson City, Missouri 65102

Dear Mr. Riedel:

RE: Memorandum of Agreement
Floodplain Development Permit/Application

Please find enclosed a signed Memorandum of Agreement executed per your letter of request dated December 17, 2002. I have also enclosed the Floodplain Development Permit/Application, which was signed by Director Hoskins.

Thank you for your attention to this matter. Lewis McCann and I greatly appreciated your efforts while conducting coordination related to the development and processing of the enclosed documents. If you have any questions, please do not hesitate to call me at 573.751.4115, Extension 3353.

Sincerely,

GENE GARDNER
POLICY COORDINATOR

GG:dcl

Enclosures

c/enc: Lewis McCann, Department of Conservation
Norm Stucky, Department of Conservation
Paul Calvert, Department of Conservation

COMMISSION

STEPHEN C. BRADFORD
Cape Girardeau

ANITA B. GORMAN
Kansas City

CYNTHIA METCALFE
St. Louis

HOWARD L. WOOD
Bonne Terre

MEMORANDUM OF UNDERSTANDING

WHEREAS, Executive Order 98-03, effective January 28, 1998, sets forth policies and regulations related to state owned and leased (interpreted herein to include those developments managed under cooperative Understandings) developments located in special flood hazard areas of the state of Missouri.

WHEREAS, Executive Order 98-03 is specifically intended to meet federal requirements of the National Flood Insurance Program (44C.F.R 60.12(a)).

WHEREAS, the purpose of this Memorandum of Understanding is to establish a specific permitting procedure between the Missouri Department of Conservation and the State Emergency Management Agency regarding implementation of Executive Order 98-03.

WHEREAS, the Department of Conservation, is constitutionally charged with the "control, management, restoration, conservation, and regulation of the bird, fish, game, forestry, and all wildlife resource of the state...."

WHEREAS, in meeting their statewide constitutional mandate, the Department of Conservation does engage in activities located in special flood hazard areas, including the floodway.

AND WHEREAS, the Department of Conservation ensures compliance with existing state and federal regulatory requirements within special flood hazard areas (e.g., Water Quality Certification, Clean Water Act, Americans with Disabilities Act).

NOW THEREFORE, I, John Hoskins, Director of the Department of Conservation, and I, Jerry B. Uhlmann, Director of the State Emergency Management Agency, do hereby mutually agree to the following as it pertains to Department of Conservation activities in the floodplain.

1. A blanket floodplain development permit will be issued to the Department of Conservation for the following activities:

a. ~~Maintenance of all existing and future (occurring subsequent to effective date of Executive Order 98-03) developments.~~ Maintenance is defined herein as the repair, upkeep or replacement of existing, previously authorized development, consistent with the original dimensions and purpose.

b. Construction of cut-and-fill balanced parking lots and access roads, fences, unenclosed pump stations and water control structures, non-walled structures, structures less than 400 square feet in plan area, fishing platforms, and features designed for fish and wildlife or bank stabilization such as:

habitat mounds, discing, cropping, floodplain revegetation, excavating, tree revetments, rock revetments, rock and log barbs, willow pole and post bank stabilization, anchored rootwads,unker structures, boulder clusters, habitat racks, and gabion toe protection.

c. Construction and maintenance of low water bridges constructed on tributaries of the mainstem, and whose cross-section is below the ordinary high water line.

d. For those future developments that are functionally dependent upon being located in a designated floodway (ex: boat ramps, riffle structures) and for which a rise in the base flood elevation may occur, the Department of Conservation will mitigate any rise by compensating for the decrease in floodway cross sectional area within the project reach. Mitigation methods will depend upon site-specific conditions and may include, but are not limited to:

- 1) Removal of material from the bank to mitigate for the rockfill and concrete placed in the channel.
- 2) In the case where material cannot be removed from the bank, a ditch may be cut on one or both sides of the boat ramp.
- 3) In the case where real estate is limited, a ephemeral pond may be constructed in the vicinity.

The Department of Conservation will also provide the State Emergency Management Agency with after-the-fact documentation, which specifies the location and dimensions of the development and associated mitigation, as well as a copy of the approved Clean Water Act, Section 404 permit.

The Department of Conservation will also provide the State Emergency Management Agency a summary of all on-going projects that are designated under this section for each calendar year by the end of January of the next year.

2. The Department of Conservation will apply for individual, site-specific floodplain development permits from the State Emergency Management Agency for those activities that occur in a special flood hazard area, including the floodway, which are not included under paragraphs 1 a-d, including levees, bridges, non cut-and-fill balanced roads and parking lots, and structures greater than 400 square feet in plan area.

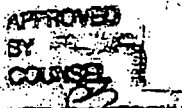
3. To enable the Department of Conservation to comply with the conditions of Executive Order 98-03, the State Emergency Management Agency will provide to the Department of Conservation with at least one set of NFIP maps for those communities with type "D" ordinances.

BE IT FURTHER AGREED that this Memorandum of Understanding shall be in effect for a minimum five years from the date of the last signature affixed hereto. The Memorandum of Understanding may be amended only by the mutual written Understanding of both parties. This Memorandum of Understanding will automatically be extended upon completion of the initial five-year period for an additional five-year period unless either party provides a written request for an amendment.

John Hoskins
John Hoskins, Director
Department of Conservation

Jerry B. Uhlmann
Jerry B. Uhlmann, Director
State Emergency Management Agency

01/03/2003
Date



12/19/02
Date

Department of Conservation Memorandum of Understanding Written December 2002

**STATE AGENCY OF MISSOURI
FLOODPLAIN DEVELOPMENT PERMIT/APPLICATION**

Application # _____ Date December 13, 2002

TO THE ADMINISTRATOR: The undersigned hereby makes application for a Permit to develop in a floodplain. The work to be performed, including flood protection works, is as described below and in attachments hereto. The undersigned agrees that all such work shall be done in accordance with the requirements of the Executive Order and all other laws and regulations of the State of Missouri.

Missouri Department of Conservation
Owner or Agent _____ Date _____

Missouri Department of Conservation
Builder _____ Date _____

P.O. Box 180
Address _____

P.O. Box 180
Address _____

Jefferson City, Missouri 65102-0180

Jefferson City, Missouri 65102-0180

Phone
(573) 751-4155

Phone
(573) 751-4155

SITE DATA

1. Location: _____ 1/4; _____ 1/4; Section _____; Range _____; Township _____
Street Address State Wide Development
2. Type of Development: Filling ☒ Grading ☒ Excavation ☒ Min Improvement ☒
Routine Maint ☒ Substantial Improv _____ New Const ☒ Other _____
3. Description of Development: See Attached Memorandum of Agreement

4. Premises: Structure size _____ ft. x _____ ft. Area of site _____ sq. ft.
Principal use _____ Accessory uses (storage, parking, etc.) _____

5. Value of Improvement (fair market) \$ _____ Pre-Improvement/Assessed value of structure \$ _____

6. Property located in a designated FLOODWAY? Yes ☒ No _____

IF ANSWERED YES, CERTIFICATION MUST BE PROVIDED PRIOR TO THE ISSUANCE OF A PERMIT TO DEVELOP, THAT THE PROPOSED DEVELOPMENT WILL RESULT IN NO INCREASE IN THE BASE FLOOD (100-YEAR) ELEVATION

7. Property located in a designated floodplain FRINGE? Yes ☒ No _____
8. Elevation of the 100-year flood (ID source) _____ MSL/NGVD
9. Elevation of the proposed development site _____ MSL/NGVD
10. Elevation/floodproofing requirement _____ MSL/NGVD
11. Other floodplain elevation information (ID and describe source) _____

12. Other permits required? Corps of Engineer 404 Permit: Yes _____ No _____ Provided _____
State Dept. of Natural Resources: Yes _____ No _____ Provided _____

☒ All provisions of Executive Order 98-03, Floodplain Management Executive Order shall be in compliance.

THIS PERMIT IS VALID UNTIL December 1, 2007

PERMIT APPROVAL/DENIAL

Plans and Specifications Approved/Denied this _____ 17th _____ Day of _____ December _____, 2002

John Hoskins
Signature of State Agency

George Riedel
Authorizing Official

John Hoskins, Director
Print Name and Title

George Riedel, Floodplain Management Manager
Print Name and Title

THIS PERMIT ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT FLOOR) OF ANY NEW OR SUBSTANTIALLY-IMPROVED RESIDENTIAL BUILDING WILL BE ELEVATED _____ FOOT/FEET ABOVE THE BASE FLOOD ELEVATION. IF THE PROPOSED DEVELOPMENT IS A NON-RESIDENTIAL BUILDING, THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE LOWEST FLOOR (INCLUDING BASEMENT) OF A NEW OR SUBSTANTIALLY-IMPROVED NON-RESIDENTIAL BUILDING WILL BE ELEVATED OR FLOODPROOFED _____ FOOT/FEET ABOVE THE BASE FLOOD ELEVATION.

THIS PERMIT IS ISSUED WITH THE CONDITION THAT THE STATE AGENCY WILL PROVIDE CERTIFICATION BY A REGISTERED ENGINEER, ARCHITECT, OR LAND SURVEYOR OF THE "AS-BUILT" LOWEST FLOOR (INCLUDING BASEMENT) ELEVATION OF ANY NEW OR SUBSTANTIALLY-IMPROVED BUILDING COVERED BY THIS PERMIT.

(MISSOURI)
JULY 15, 2002

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DOCUMENT 003144 – CONTRACTOR REGISTRATION PERMIT(S)

1.1 PERMIT INFORMATION

- A. The contractor shall comply with all conditions of the following Permit(s), and their attachments, as well as other applicable federal, state and local permits throughout the entire contract period.
- B. This Project will require a permit from the City of Branson Utilities Department for contractors performing plumbing services. The contractor shall obtain all necessary permits before any part of the work is performed on this Project.

END OF DOCUMENT 003144

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City Of Branson

110 W. Maddux * Suite 200 * Branson, Missouri * 65616
417-334-3345 (phone) * 417-335-6042 (fax)

CONTRACTOR REGISTRATION

Application Date: _____

1. ☐ New Business ☐ Change in Name ☐ Change in Ownership

2. Name of Corporation or LLC:
(If applicable)

Anticipated Start Date:

3. NAME OF BUSINESS:
(Must match business card)

*In State company-Must register Name of Business at www.sos.mo.gov

*Out-of-State company-Must register as a transient employer by calling (573) 751-0459

4. Phone:

FEIN:

E-Mail:

5. Business Address:

Street:

City, State, Zip:

6. Mailing Address:(if different from business address)

Street:

City, State, Zip:

7. Type of ownership: ☐ Sole Proprietor ☐ Partnership
☐ Limited Liability Company ☐ Corporation

8. Name of Owner(s), Partners, Corporate Officers, etc:

Name:

Title:

Phone Number:

Home Address:

Name:

Title:

Phone Number:

Home Address:

9. Business Description: Give a concise description of the business to be conducted. Be certain that the types of business transactions to be conducted are described. Any misrepresentation in the description of the business by the applicant may be sufficient cause for the license to be rejected or revoked.

10 & 11. Not applicable

12. License Fees (please circle): 0-4 employees--\$50.00 5 or more employees--\$75.00

License Year: May 1 to April 30*

*Fees prorated: Nov 1 to Jan 31-reduced by 50%

*Fees prorated: Feb 1 to Apr 30 - reduced by 75%

13. ***Worker's Compensation Is required by the State unless exempt***

Affidavit of Worker's Compensation Exemption: I understand that under Missouri State law an employer is required to have worker's compensation insurance, unless exempt. I also understand that if I do carry workers' compensation, the City of Branson is required by law to have this on file. I hereby state that this business qualified to be exempted from carrying workers' compensation and execute this affidavit of my own free act and deed.

Signature:

Certification

(I), (We), the undersigned have answered all questions in the above application, and the best of my (our) belief all answers are true and correct. (I) (We) further understand that disclosure of any false or misleading or any incomplete answers in the above could result in automatic denial, or revocation, of the license if already issued:

In addition, (I) (We) acknowledge and understand the following:

- 1) Compensation Insurance, where applicable
- 2) (I) (We) must notify the Business License Division of any change including business name, addresses, ownership, corporate officers, management or key employee, where applicable.
- 3) (I) (We) are solely responsible for maintaining current and active licenses application to the operation of our business, including the payment of fees in accordance with the appropriate licensing categories.
- 4) (I) (We) may be subject to issuance of a misdemeanor citation for each and every day (I) (We) are in violation of any of the above.

Sign and Print Name:

Contact
Telephone #

Copy of driver's license required

I understand that I cannot commence business or pull permits until the contractors license is approved and issued.



CITY OF BRANSON

Utilities Department

616 W Pacific Street • Branson, Missouri 65616
(417) 337-8565 • Fax (417) 334-9518

NOTICE TO CONTRACTORS:

The City of Branson Utilities Division would like all contractors performing plumbing services within the City of Branson to be aware the City has adopted the 2015 International Plumbing Code, 2015 International Residential Code and the 2015 International Fire Code. As part of adopting these codes the City has also amended sections of the Code to meet specific requirements of the City of Branson. In addition to these adopted Codes the City has revised the sewer connection application which contains specific requirements pertaining to sewer service installation and repair. Please keep in mind that any sewer service line installation or repair requires a permit through the City's Planning and Development Department. Contractors or property owners must also deposit a sewer bond of \$500.00 with the Finance Department before a permit will be issued. If you have any questions feel free to contact us at 417-243-2731 or 417-243-2740.

The City requests the signature of **all contractors** working within City limits as acknowledgement of your understanding of the above requirements.

Mike Ray
City of Branson
Utilities Director

Business Name: _____

Phone # _____

Contractor Name (Print) _____

Contractor Signature: _____

Date: _____

DOCUMENT 003145 – APPLICATION FOR CONSTRUCTION PERMIT(S)

1.1 PERMIT INFORMATION

- A. The contractor shall comply with all conditions of the following Permit(s), and attachments, as well as other applicable federal, state and local permits throughout the entire contract period.
- B. This Project will require a permit from the City of Branson; the following pages contain the Application for Construction Permit.

END OF DOCUMENT 003145

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City of Branson

APPLICATION FOR CONSTRUCTION PERMIT

Project Name		Project Address:	
Owner	Phone	Brief Description of Work	
	Cell		
Mailing Address	Email		
City of Branson Licensed Contractor	Phone	Estimated Construction Value of Project	
	Cell		
Mailing Address	Email still		
Missouri Registered Architect/Engineer	Phone	Original Signature of Applicant I hereby certify I am the owner or duly authorized owner's agent, I have read this application and all information is correct. I further certify I have read, understand, and will comply with all the provisions outlined hereon. I also certify the plot plan submitted is a complete and accurate plan showing any and all existing and proposed structures on the subject property. PROVISIONS: The issuance of a permit shall not be construed to release the owner or owner's agents from the obligation to comply with the provisions of all laws and ordinances, including federal, state, and local jurisdictions, which regulate construction and performance of construction. A permit will become null and void if the construction work authorized has not begun within 180 days from the date of issuance or if work is suspended or abandoned for 180 days prior to the final inspection.	
	Cell		
Mailing Address	Email lkjh		
<input type="checkbox"/> Residential Project <input type="checkbox"/> Commercial Project (requires 2 wetseal drawings AND 5 copies by a Missouri registered design professional.)		Application Signature _____ Date _____ Please print name _____ This Section For Official Use Only	
If New Construction check here <input type="checkbox"/> or check all below that apply to your project.			
<div style="display: flex; flex-wrap: wrap;"> <div style="width: 50%;"><input type="checkbox"/> Existing Building</div> <div style="width: 50%;"><input type="checkbox"/> Repair</div> <div style="width: 50%;"><input type="checkbox"/> Alteration</div> <div style="width: 50%;"><input type="checkbox"/> Addition</div> <div style="width: 50%;"><input type="checkbox"/> Mechanical Only</div> <div style="width: 50%;"><input type="checkbox"/> Plumbing Only</div> <div style="width: 50%;"><input type="checkbox"/> Electrical Only</div> <div style="width: 50%;"><input type="checkbox"/> Solar Panel</div> <div style="width: 50%;"><input type="checkbox"/> Park Model Replacement</div> <div style="width: 50%;"><input type="checkbox"/> Other</div> <div style="width: 50%;"><input type="checkbox"/> Re-Roof</div> <div style="width: 50%;"><input type="checkbox"/> Deck</div> <div style="width: 50%;"><input type="checkbox"/> New Electrical Service</div> </div> <p style="margin-top: 10px;">← If you checked either of the 3 boxes to the left, please complete and attach a Re-Roof, Deck, or Electrical Service Installation Worksheet.</p>			
Are you building in a floodplain? <input type="checkbox"/> Yes → If you checked Yes, please complete and attach a Floodplain Development Application Form. <input type="checkbox"/> No		Application Reviewed and Approved By: _____ Date _____	
Are building plans or construction documents being supplied as part of this application? <input type="checkbox"/> Yes <input type="checkbox"/> No		Building _____	
This Section For Official Use Only		Engineering/Public Works _____	
Square Feet	# of Seats	# of Rooms	Occupancy Load
In Floodplain	Hazard Type	Construction Type	Use Group
Fire		Health	
Landscaping/Planning		Utilities	

Office Use Only	
Permit Number	
Date Applied	
Date Issued	
Fees	
Project Type Category	
# of Sets of Plans Submitted	
<input type="checkbox"/> Plans In File <input type="checkbox"/> Rolled Plans	
Other Documents Submitted	
<input type="checkbox"/> Roof/Deck <input type="checkbox"/> Electrical Serv. <input type="checkbox"/> Structural Eng. Report <input type="checkbox"/> Floodplain Dev. App.	
Refund deposit to:	
<input type="checkbox"/> Owner <input type="checkbox"/> Contractor <input type="checkbox"/> Arch/Eng	

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City of Branson
Planning and Development
110 W. Maddux St., Ste.215
Branson, MO 65616
417-337-8549/Fax 417-334-2391

Electrical Service Installation Worksheet

Project Address _____

Permit # _____
Office Use

Contractor or Owner Name _____

Service Provider (check a box): ☐ Empire Electric ☐ White River Electric

Electrical Service Upgrade(check a box): ☐ Residential ☐ Commercial

Please provide the following information.

1. Current size of service: _____ amp.
2. Current grounding system:
☐ ground rod ☐ metal water service ☐ plate
☐ grounding ring ☐ concrete encased electrode
3. Proposed size of service upgrade : _____ amp.
4. Proposed grounding system update:
☐ ground rod ☐ grounding ring ☐ concrete encased electrode
☐ plate
5. Current service: ☐ overhead ☐ underground
6. Proposed service: ☐ overhead ☐ underground

Per City of Branson Code Sec 18-47:

- A disconnecting means shall be installed at a readily accessible location outside of a building or structure.
- Where an owner is doing work on owner's personal residence, all wiring from the point of utility connection into the structure shall be of copper conductors.

Per NEC 2014:

- The combination meter/main service disconnect enclosure to be installed shall be rated as a NEMA 3R.
- Service Grounding Conductors shall be sized accordingly as per 250.66 and Service Conductors as per 310.15.(B) (6) and properly identified.
- Connection of the Main Bonding Jumper as per 250.28
- Disconnect enclosures shall be properly/permanently identified, not located above stairs, properly bonded.
- Service riser conduit is to be of Schedule 80 if PVC , properly secured and clearances observed.
- If a metal sweep is used less that 18" below grade, it is to be bonded with the grounding conductor.

Note: If a new service is replacing a combination disconnect/breaker panel that is located on the inside of the building, separate grounding and grounded buss terminals will be required and all conductors appropriately located. In addition, if this electric service installation is for new construction in multi-unit buildings, the drywall in the

immediate area of the breaker panel and a GFIC must be installed (1-per floor). The panel cover must also be available for immediate installation after inspection.

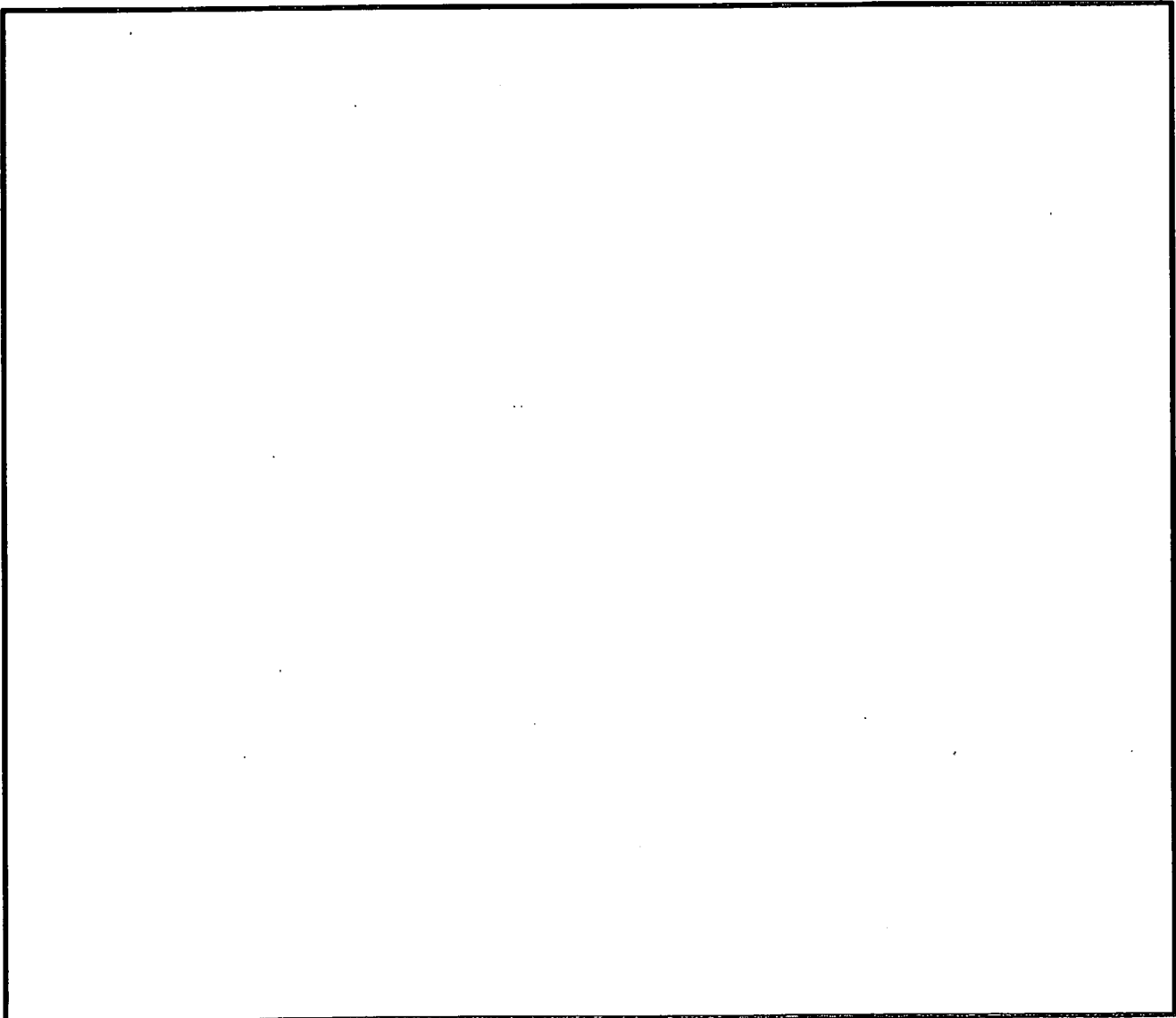
After obtaining a permit and initiating the install, call the inspection line at 417-337-8505 for a rough in inspection to inspect any/all of the following :

- trench
- conductor applications
- riser mounting/attachment
- bonding and grounding electrode placement/connections

If approved, an orange "Approved" sticker will be placed on the enclosure and the Service Provider can be contacted for service activation. A final inspection is required. Please call the aforementioned inspection line.

In the space below, or on a separate attached sheet, please diagram an overhead view, (site plan), showing the current and proposed service locations as well as any trenching and setback dimensions which will be incorporated into the work.

SITE PLAN





Utilities Plan Review – original
Water Distribution – 1 copy
Finance – 1 copy

CITY OF BRANSON
WATER CONNECTION APPLICATION

PROPERTY OWNER'S NAME: _____

PROPERTY OWNER'S MAILING
ADDRESS: _____

MONTHLY WATER BILLING ADDRESS: _____

PROPERTY OWNER'S PHONE: _____ DATE: _____

INSTALLED WATER METER BILLING NAME, ADDRESS & PHONE NUMBER (If different
than above)

METER LOCATION & ADDRESS: _____

SIZE(S) & INTENDED SERVICE OF METER(S) OR TAP(S):

Domestic	Irrigation	Fire Tap
QTY _____ SIZE _____	QTY _____ SIZE _____	QTY _____ SIZE _____

ORDINANCE #2013-0178 Sect. 90-26

For any installation of new meter service, the applicant shall pay all city costs for the installation including meter, parts, materials, labor and equipment.

A DEPOSIT WILL BE REQUIRED PRIOR TO WATER BEING TURNED ON!

Water pressure reducing valve or regulator: Where water pressure within a building exceeds 80 psi static, an approved water pressure reducing valve conforming to ASSE 1003 with strainer shall be installed (by the property owner's plumbing contractor) to reduce the pressure in the building water distribution piping to 80 psi static or less. Exceptions to this requirement are service lines to sill cocks and outside hydrants, and main supply risers where pressure for the mains is reduced to 80 psi or less at individual fixtures.

Date of installation may vary depending on availability of parts. Please allow for up to eight (8) weeks for installation.

I do hereby agree that the above billing address is the responsible party for payment of meter invoices. All payments are due and delinquent after 30 days of invoicing.

(Signature)



DATE: _____

**CITY OF BRANSON
SEWER CONNECTION APPLICATION**

NAME: _____ PHONE #: _____

DRIVERS LICENSE #: _____ DATE OF BIRTH: _____

MAILING ADDRESS: _____

SEWER CONNECTION 911 ADDRESS: _____

IS THE SEWER CONNECTION ADDRESS LOCATED WITHIN THE CITY LIMITS: ☐ YES ☐ NO

PROPERTY OWNER'S NAME: _____ PHONE #: _____

(If different than above)

PROPERTY OWNER'S MAILING ADDRESS: _____

(If different than above)

IS THE SEWER SERVICE AT THE LOCATION FOR:

☐ Primary Home ☐ Vacation Home ☐ Rental Residence ☐ Business ☐ Other/ Explain: _____

NAME OF WATER COMPANY THAT SERVES THIS PROPERTY: _____

CONTRACTOR NAME: _____ PHONE #: _____

CITY OF BRANSON BUILDING SEWER SPECIFICATIONS AND REQUIREMENTS

1. Customer shall pay for all costs associated to connection of sewer service to city sewer main including all construction cost, permit fees, inspection fees and sewer system connection charges.
2. Connections must be completed in accordance with the International Plumbing/Residential code and all City specifications and requirements listed in chapter 90 of the municipal code.
3. Contractor or owner shall deposit a bond of \$500 with the Finance Department and Contractors shall have a valid Contractors License through the City of Branson before a permit will be issued.
4. Call 1-800-DIG-RITE for locates on utilities prior to excavation.
5. Call the Utilities Division (417-243-2731) at least 24 hours prior for all inspections and testing.

I do hereby agree to comply with all of the above City specifications and requirements and to pay all charges for water and/or sewer service at the above address as long as said service remains in my name. I will notify the City of Branson in the event I discontinue service in my name at the above address and will submit a new forwarding mailing address at that time.

Applicant Name (Print): _____ Applicant Signature: _____

Starting Date of Service: _____

(Office use only)

DOCUMENT 003146 – MISSOURI STATE OPERATING PERMIT(S)

1.1 PERMIT INFORMATION

- A. The contractor shall comply with all conditions of the following Permit(s), and attachments, as well as other applicable federal, state and local permits throughout the entire contract period.
- B. The following pages are the Owner's Missouri State Operating Permit, General Operating Permit issued by the Department of Natural Resources.

END OF DOCUMENT 003146

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STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



MISSOURI STATE OPERATING PERMIT

General Operating Permit

In compliance with the Missouri Clean Water Law, (chapter 644 R.S. Mo as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended.

Permit No: MOR100023
Owner: Missouri Department of Conservation
Address: 2901 W. Truman Blvd.
Jefferson City, MO 65102

Continuing Authority: Missouri Dept of Conservation
P.O. Box 180
Jefferson City, MO 65102

Facility Name: Missouri Department of Conservation
Facility Address: 2901 W. Truman Blvd.
P.O. Box 180
JEFFERSON CITY, MO 65102

Legal Description: NW 1/4, NE 1/4, Sec. 3, T44N, R12W, Cole County
UTM Coordinates: 567023.900/4272154.100
Receiving Stream: Various Statewide (U)
First Classified Stream - ID#: Missouri R. (P) 701.00
USGS# and Sub Watershed#: 10300102 -

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein.

FACILITY DESCRIPTION All Outfalls SIC #1629

All Outfalls - Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading and other activity that results in the destruction of the root zone and/or land disturbance activity that is reasonably certain to cause pollution of waters of the state)

This permit authorizes only wastewater, including storm water, discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System. It does not apply to other regulated areas. This permit may be appealed in accordance with RSMo Section 644.051.6 and 621.250, 10 CSR 20-6.020, and 10 CSR 20-1.020.

May 31, 2012

Issue Date

Sara Parker Pauley
Sara Parker Pauley, Director
Department of Natural Resources

May 30, 2017

Expiration Date

John Madras
John Madras
Director, Water Protection Program

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A. APPLICABILITY

1. This general permit authorizes the discharge of stormwater and certain non-stormwater discharges from land disturbance sites that disturb one or more acres of land or disturb less than one acre when part of a larger common plan of development or sale that will disturb a cumulative total of one or more acres over the life of the project.

This general permit also authorizes the discharge of stormwater and certain non-stormwater discharges from smaller projects where the Missouri Department of Natural Resources (Department) has exercised its discretion to require a permit [10 CSR 20-6.200 (1)(B)].

This general permit is issued to a city, county, state or federal agency or other governmental jurisdiction for land disturbance projects performed by or under contract to the permittee. A stormwater control plan or stormwater pollution prevention plan (SWPPP) must be developed prior to issuance of this permit. These plans must include a narrative of the types and appropriate uses of Best Management Practices (BMPs) for erosion and sediment control and stormwater management.

All water pollution controls on land disturbance sites shall conform to the storm water control program and/or SWPPP of the city, county or other governmental jurisdiction in which the land disturbance activity is occurring. These storm water control programs and/or SWPPPs shall be developed prior to permit issuance. The requirements of the stormwater control program and/or SWPPP must be at least as stringent as those described in this permit and 10 CSR 20-6.200. If the permittee is a regulated municipal separate stormwater system (MS4), the stormwater program and/or SWPPP must comply with the permittee's MS4 permit. The Department may enforce the requirements of the stormwater program and/or SWPPP.

All projects covered under this permit must also be identified as part of the Missouri State Operating Permit covered area and must have a SWPPP developed specific to the project site. The site specific SWPPP shall be developed prior to removal of any vegetation or site disturbance. This SWPPP must contain all the SWPPP requirements of this permit.

Any site owner/operator subject to these requirements for stormwater discharges and who disturbs land *prior* to permit issuance from the Department or prior to the development of the SWPPP is in violation of both State and Federal Laws.

The legal owner of the property, the right-of-way or the easement on which the site is located and the operator are responsible for compliance with this permit.

2. This permit authorizes discharges from construction support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided that appropriate stormwater controls are designed, installed, maintained and provided:
 - a. The support activity is directly related to the construction site required to have permit coverage for stormwater discharges;
 - b. The support activity is not a commercial operation; and
 - c. The support activity does not continue to operate beyond the completion of the construction activity at the project it supports.

It is the permittee that is responsible for compliance with this permit for any construction support activities.

3. This permit authorizes non-stormwater discharges from the following activities provided that these discharges are addressed in the SWPPP required by this general permit:
 - a. De-watering activities if there are no contaminants other than sediment present in the discharge, and the discharge is treated as specified in Requirements, Section C.10.1. of this permit;
 - b. Flushing water hydrants and potable water lines;
 - c. Water only (i.e., without detergents or additives) rinsing of streets and buildings; and
 - d. Site watering to establish vegetation.
4. This general permit does not authorize the placement of fill materials in flood plains, the obstruction of stream flow, directing stormwater across private property not owned or operated by the permittee, or changing the channel of a defined drainage course. This general permit addresses only the quality of the stormwater runoff and the minimization of off-site migration of sediments and other water contaminants.
5. This general permit does not authorize any discharge to waters of the state of sewage or pollutants including but not limited to:
 - a. Any hazardous material, oil, lubricant, solid waste or other non-naturally occurring substance from the site, including fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;
 - b. Soaps or solvents used in vehicle and equipment washing;
 - c. Hazardous substances or petroleum products from an on-site spill or handling and disposal practices;
 - d. Wash and/or rinse waters from concrete mixing equipment including ready mix concrete trucks, unless managed by an appropriate control. Any such pollutants must be adequately treated and addressed in the SWPPP, and cannot be discharged to waters of the state;
 - e. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;
 - f. Wastewater generated from air pollution control equipment or the containment of scrubber water in lined ponds;
 - g. Domestic wastewaters, including gray waters; or
 - h. Industrial stormwater runoff.
6. The Department reserves the right to revoke or deny coverage under this general permit to applicants for stormwater discharges from land disturbance activities at sites that have contaminated soils that will be disturbed by the land disturbance activity or where such materials are brought to the site to use as fill or borrow. A site-specific permit may be required to cover such activities.
7. If Department may require any person authorized by a general permit to apply for and obtain an individual operating permit [10 CSR 20-6.010 (13) (C)].

The Department may require the permittee to apply for and obtain a site-specific or different general permit if:

- a. The permittee is not in compliance with the conditions of this general permit;
- b. The discharge no longer qualifies for this general permit due to changed site conditions and/or regulations; or
- c. Information becomes available that indicates water quality standards have been or may be violated.

8. The permittee will be notified in writing of the requirement to apply for a site-specific permit or a different general permit. When a site-specific permit or different general permit is issued to the authorized permittee, the applicability of this general permit to the permittee is automatically terminated upon the effective date of the site specific or different general permit.
9. Any owner/operator authorized by a general permit may request to be excluded from the coverage of the general permit and apply for a site-specific permit [10 CSR 20-6.010 (13)(D)].
10. This permit does not authorize land disturbance activity in jurisdictional waters of the United States as defined by the Army Corps of Engineers, unless the permittee has obtained the required 404/401 permit. Land disturbance activities may not begin in the affected portions of the site until the required 404/401 permits have been obtained.
11. This permit does not supersede compliance with the Historic Preservation Act or the Endangered Species Act.
12. This permit does not supersede any requirement for obtaining project approval under an established local authority.
13. This permit is not transferable to other owners or operators.

B. EXEMPTIONS FROM PERMIT REQUIREMENTS

1. Facilities that discharge all stormwater runoff directly to a combined sewer system are exempt from stormwater permit requirements.
2. Land disturbance activity as described in [10 CSR 20-6.200 (1) (B)] and [10 CSR 20-6.010 (1) (B)] where water quality standards are not exceeded.
3. Linear, strip, or ribbon construction (as described in [10 CSR 20-6.200 (1) (B) 8]) where water quality standards are not exceeded.
4. Sites that disturb less than one acre of total land area as described in [10 CSR20-6.200 (1)(B)7], that are not part of a common plan or sale and that do not cause any violations of water quality standards, and are not otherwise designated by the Department as requiring a permit.
5. Agricultural stormwater discharges and irrigation return flows as described in [10CSR 20-6.200 (1) (B) 6].

C. REQUIREMENTS

These requirements do not supersede nor remove any requirement to comply with county or other local ordinances [10 CSR20-6.010(14) (D)]:

1. This permit is to ensure the design, the installation and the maintenance of effective erosion controls and sediment controls to minimize the discharge of pollutants. At minimum, such controls must be designed, installed and maintained to:
 - a. Control stormwater volume and velocity within the site to minimize soil erosion;
 - b. Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion;
 - c. Minimize the amount of soil exposed during construction activity;
 - d. Minimize the disturbance of steep slopes;

- e. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle size expected to be present on the site.;
 - f. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible; and
 - g. Minimize soil compaction and, unless infeasible, preserve topsoil.
2. The primary requirement of this permit is the development and implementation of a SWPPP which incorporates site specific practices to best minimize the soil exposure, soil erosion, and the discharge of pollutants. The permittee shall fully implement the provisions of the SWPPP required under this part as a condition of this general permit throughout the term of all land disturbance projects covered under this permit.
 3. The permittee must inspect all land disturbance sites as described in C.13 of this permit.
 4. The permittee shall provide a list of active land disturbance sites to the Department on a quarterly basis. The list shall contain the name of the project, location (including the County), name of the primary receiving water(s) for each project, description of the project, number of acres disturbed, percent completion of the project and projected date of completion. The permittee shall submit quarterly reports each January, April, July and October. The Department must receive reports by the end of the specified month.
 5. The permittee is required to keep a current copy of the SWPPP at an easily accessible location so that it can be made available at the time of an onsite inspection by the Department or local agency approving stormwater management plans.

The SWPPP must:

- a. List and describe all outfalls or primary receiving water(s) for the project;
- b. Incorporate required practices identified below;
- c. Incorporate erosion control practices specific to site conditions;
- d. Provide for maintenance and adherence to the plan;
- e. Discuss whether or not a 404/401 Permit is required for the project; and
- f. Name the person responsible for inspection, operation and maintenance of BMPs.

The purpose of the SWPPP is to ensure; the design, implementation, management and maintenance of Best Management Practices (BMPs) in order to prevent sediment and other pollutants in stormwater discharges associated with the land disturbance activities; compliance with the Missouri Water Quality Standards; and compliance with the terms and conditions of this general permit.

The permittee shall select, install, use, operate and maintain appropriate BMPs for the permitted site. The following manuals are acceptable resources for the selection of appropriate BMPs.

Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Activities (Document number EPA 833-R-06-004) published by the United States Environmental Protection Agency (USEPA) in May 2007. This manual as well as other information, including examples of construction SWPPPs, is available at the USEPA internet site at <http://cfpub1.epa.gov/npdes/stormwater/swppp.cfm>; and

The latest version of *Protecting Water Quality: A field guide to erosion, sediment and stormwater best management practices for development sites in Missouri*, published by the Missouri Department of Natural Resources. This manual is available on the Department's internet site at: <http://www.dnr.mo.gov/env/wpp/wpcp-guide.htm>.

The permittee is not limited to the use of these guidance manuals. Other guidance publications may be used to select appropriate BMPs. However, all BMPs should be described and justified in the SWPPP.

6. SWPPP Requirements: The following information and practices shall be provided for in the SWPPP:
 - a. Nature of the Construction Activity: The SWPPP briefly must describe the nature of the construction activity, including:
 - 1) The function of the project (e.g., low density residential, shopping mall, highway, etc.);
 - 2) The intended sequence and timing of activities that disturb the soils at the site;
 - 3) Estimates of the total area expected to be disturbed by excavation, grading, or other construction activities including off-site borrow and fill areas; and
 - 4) A general map (e.g., United States Geological Survey quadrangle map, a portion of a city or county map, or other map) with enough detail to identify the location of the construction site and waters of the United States within one mile of the site.
 - b. Site Map: The SWPPP must contain a legible site map showing the site boundaries and outfalls and identifying:
 - 1) Direction(s) of stormwater flow and approximate slopes anticipated after grading activities;
 - 2) Areas of soil disturbance and areas that will not be disturbed (or a statement that all areas of the site will be disturbed unless otherwise noted);
 - 3) Location of major structural and non-structural BMPs identified in the SWPPP;
 - 4) Locations where stabilization practices are expected to occur;
 - 5) Locations of off-site material, waste, borrow or equipment storage areas;
 - 6) Locations of all waters of the United States (including wetlands);
 - 7) Locations where stormwater discharges to a surface water; and
 - 8) Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.
 - c. Site Description: In order to identify the site, the SWPPP shall include facility and receiving water(s) information. The SWPPP shall have sufficient information to be of practical use to contractors and site construction workers to guide the installation and maintenance of BMPs.
 - d. Effluent Limits: The permittee must select control measurements (e.g., BMPs, controls, practices, etc.) to meet effluent limits found in Section E.1. of this permit. All control measures must be properly selected, installed and maintained in accordance with any relevant manufacturer specifications and good engineering practices to ensure stormwater outfall discharges do not cause water quality problems. The permittee must implement the control measures from commencement of the construction activity until final stabilization is complete unless the exception noted in Section C.6.i. of this permit applies.
 - e. Selection of Temporary and Permanent Non-Structural BMPs: The permittee shall select appropriate non-structural BMPs for use at the site and list them in the SWPPP. The SWPPP shall require existing vegetation to be preserved where practical. For surface waters located on or immediately adjacent to the site, the permittee must provide at minimum a 25-foot buffer of undisturbed natural vegetation between the disturbed portions of the site and the surface water unless infeasible or where there is a more stringent local requirement. The buffer is measured perpendicularly from the ordinary high water mark or the bank edge, whichever is further landward from the water. The time period for disturbed areas to be without vegetative cover is to be minimized to the maximum extent practicable. Examples of non-structural BMPs which the permittee should consider specifying in the SWPPP include preservation of trees and mature vegetation, protection of existing vegetation

for use as buffer strips, mulching, sodding, temporary seeding, final seeding, geotextiles, stabilization of disturbed areas, preserving existing stream channels as overflow areas when channel straightening or shortening is allowed, soil stabilizing emulsions and tackifiers, mulch tackifiers, stabilized site entrances/exits and other appropriate BMPs.

- f. Selection of Temporary and Permanent Structural BMPs: The permittee shall select appropriate structural BMPs for use at the site and list them in the SWPPP. Examples of structural BMPs that the permittee should consider specifying in the SWPPP include diverting flows from undisturbed areas away from disturbed areas, silt (filter fabric and/or straw bale) fences, earthen diversion dikes, drainage swales, sediment traps, rock check dams, subsurface drains (to gather or transport water for surface discharge elsewhere), pipe slope drains (to carry concentrated flow down a slope face), level spreaders (to distribute concentrated flow into sheet flow), storm drain inlet protection and outlet protection, reinforced soil retaining systems, gabions, temporary or permanent sediment basins and other appropriate BMPs.
- g. Description of BMPs: The SWPPP shall include a description of both structural and non-structural BMPs that will be used at the site.

The SWPPP shall provide the following general information for each BMP which will be used one or more times at the site:

- 1) Physical description of the BMP;
- 2) Site and physical conditions that must be met for effective use of the BMP;
- 3) BMP installation/construction procedures, including typical drawings; and
- 4) Operation and maintenance procedures for the BMP.

The SWPPP shall provide the following information for each specific instance where a BMP is to be installed:

- 1) Whether the BMP is temporary or permanent;
- 2) Where, in relation to other site features, the BMP is to be located;
- 3) When the BMP will be installed in relation to each phase of the land disturbance procedures to complete the project; and
- 4) Site conditions that must be met before removal of the BMP if the BMP is not a permanent BMP.

- h. Disturbed Areas: Slopes for disturbed areas must be defined in the SWPPP. A site map or maps defining the sloped areas for all phases of the project must be included in the SWPPP.

Temporary stabilization is to take place where soil disturbing activities will cease on any portion of the site and are not planned to resume for a period exceeding 14 calendar days. Temporary stabilization must be initiated immediately upon knowing the duration is more than 14 days. Temporary stabilization must be completed within 7 calendar days. Temporary stabilization shall consist of well-established and maintained BMPs that are reasonably certain to protect waters of the state from sediment pollution over an extended period of time. This may require adding more BMPs to an area than is normally used during daily operations. These BMPs may include a combination of sediment basins, check dams, sediment fences and mulch. The types of BMPs used must be suited to the area disturbed, taking into account the number of acres exposed and the steepness of the slopes. If the slope of the area is greater than 3:1 (3 feet horizontal to one foot vertical) or if the slope is greater than 3% and greater than 150 feet in length, then the permittee shall establish temporary stabilization within seven days of ceasing operations on that part of the site.

Final stabilization of disturbed areas must be initiated immediately and completed within 7 calendar days whenever any clearing, grading, excavating or other earth disturbing activities have permanently ceased on any portion of the site.

Allowances to the 7 day completion period for temporary and final stabilization may be made due to weather and equipment malfunctions. The use of allowances shall be documented in the SWPPP.

- i. Installation: The permittee shall ensure the BMPs are properly installed at the locations and relative times specified in the SWPPP. Peripheral or border BMPs to control runoff from disturbed areas shall be installed or marked for preservation before general site clearing is started. Note that this requirement does not apply to earth disturbances related to initial site clearing and establishing entry, exit and access of the site, which may require that stormwater controls be installed immediately after the earth disturbance. Stormwater discharges from disturbed areas which leave the site shall pass through an appropriate impediment to sediment movement such as a sedimentation basin, sediment traps and silt fences prior to leaving the land disturbance site. A drainage course change shall be clearly marked on a site map and described in the SWPPP. The location of all BMPs must be indicated on a site map, included in the SWPPP.
- j. Sedimentation Basins: The SWPPP shall include a sedimentation basin for each drainage area with ten or more acres disturbed at one time. The sedimentation basin shall be sized to contain a volume of at least 3,600 cubic feet per each disturbed acre draining thereto. Accumulated sediment shall be removed from the basin when basin is 50% full. When discharging from basins and impoundments, utilize outlet structures that withdraw water from the surface unless infeasible. Discharges from the basin shall not cause scouring of the banks or bottom of the receiving stream. The SWPPP shall require the basin be maintained until final stabilization of the disturbed area served by the basin.

Where use of a sediment basin is impractical, the SWPPP shall evaluate and specify other similarly effective BMPs to be employed to control erosion and sediment delivery. These similarly effective BMPs shall be based on good engineering practices. The BMPs must provide equivalent water quality protection to achieve compliance with this permit. The SWPPP shall require both temporary and permanent sedimentation basins to have a stabilized spillway to minimize the potential for erosion of the spillway or basin embankment.

- k. Pollution Prevention Measures: The SWPPP shall include BMPs for pollution prevention measures. At minimum such measures must be designed, installed, implemented and maintained to:
 - 1) Minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other wash waters. Wash waters must be treated in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge ;
 - 2) Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste, and other materials present on the site to precipitation and to stormwater; and
 - 3) Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures. Included but not limited to the installation of containment berms and use of drip pans at petroleum product and liquid storage tanks and containers.

1. Dewatering: Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, are prohibited unless managed by appropriate controls. The SWPPP shall include a description of any anticipated dewatering methods including the anticipated volume of water to be discharged and the anticipated maximum flow discharged from these dewatering activities expressed in gallons per minute. Maximum flow may be stated in the SWPPP as an estimate based on the type and capacity of equipment being used for dewatering. The SWPPP shall call for specific BMPs designed to treat water pumped from trenches and excavations and in no case shall this water be pumped off-site without being treated by the specified BMPs. When discharging from basins and impoundments utilize outlet structures that withdraw water from the surface, unless infeasible.
- m. Roadways: Where applicable, upon installation of or connection to roadways, all efforts should be made to prevent the deposition of earth and sediment onto roadways through the use of proper BMPs. Stormwater inlets susceptible to receiving sediment from the permitted land disturbance site shall have curb inlet protection. Where stormwater will flow off the end of where a roadway terminates, a sediment catching BMP such as gravel berm or silt fence shall be provided. Roadways and curb inlets shall be inspected weekly or following a rainfall that generates a run-off and cleaned as necessary to maintain a clean roadway and drainage system. Where practicable, construction entrance BMP controls shall be used to prevent sediment track-out.
7. Good housekeeping practices shall be maintained at all times to keep waste from entry into waters of the state. Solid and hazardous waste management include providing trash containers and regular site clean-up for proper disposal of solid waste such as scrap building material, product/material shipping waste, food containers and cups, and providing containers and proper disposal of waste paints, solvents and cleaning compounds. The provision of portable toilets for proper disposal of sanitary sewage and the storage of construction materials should be kept away from drainage courses and low areas.
8. All fueling facilities present shall at all times adhere to applicable federal and state regulations concerning underground storage, above ground storage and dispensers.
9. Hazardous wastes that are transported, stored, or used for maintenance, cleaning, or repair shall be managed according to the provisions of the Missouri Hazardous Waste Laws and Regulations.
10. All paint, solvents, petroleum products, petroleum waste products and storage containers such as drums, cans, or cartons shall be stored according to BMPs. The materials exposed to precipitation shall be stored in watertight, structurally sound, closed containers. All containers shall be inspected for leaks or spillage during the once per week inspection of BMPs.
11. Amending/Updating the SWPPP: The permittee shall amend and update the SWPPP as appropriate during the term of the land disturbance activity. The permittee shall amend the SWPPP at a minimum whenever the:
 - a. Design, operation, or maintenance of BMPs is changed;
 - b. Design of the construction project is changed that could significantly affect the quality of the stormwater discharges;
 - c. Permittee's inspections indicate deficiencies in the SWPPP or any BMP;
 - d. The Department notifies the permittee in writing of deficiencies in the SWPPP;
 - e. SWPPP is determined to be ineffective in minimizing or controlling erosion and sedimentation (e.g., there is visual evidence of excessive site erosion or excessive sediment deposits in streams or lakes);
 - f. Settleable Solids from a stormwater outfall exceed 2.5 ml/L; and
 - g. The Department determines violations of water quality standards may occur or have occurred.

12. An individual shall be designated by the permittee as responsible for environmental matters. The individual responsible for environmental matters shall have a thorough and demonstrable knowledge of the site's SWPPP and sediment and erosion control practices in general. The individual responsible for environmental matters or a designated inspector knowledgeable in erosion, sediment and stormwater control principles shall inspect all structures that function to prevent pollution of waters of the state including those for material, waste, borrow, or equipment storage and maintenance areas that are covered by this permit. These inspections shall be conducted in accordance with No. 13 of these requirements.
13. Site Inspection Reports: The permittee (or a representative of the permittee) shall conduct regularly scheduled inspections at least once per seven calendar days. These inspections shall be conducted by a qualified person, one who is responsible for environmental matters at the site, or a person trained by and directly supervised by the person responsible for environmental matters at the site. For disturbed areas that have not been finally stabilized, all installed BMPs and other pollution control measures shall be inspected for proper installation, operation and maintenance. All stormwater outfalls shall be inspected for evidence of erosion or sediment deposition. When practicable the receiving stream shall also be inspected for 50 feet downstream of the outfall. Any structural or maintenance problems shall be noted in an inspection report and corrected within seven calendar days of the inspection. If a rainfall causes stormwater runoff to occur on-site, the BMPs must be inspected. These inspections must occur within 48 hours after the rain event has ceased during a normal work day and within 72 hours on the next business day if the rain event ceases during a non-work day such as a weekends or holiday. The total rainfall measured for that day must be recorded. A properly maintained rain gauge must be kept on site or the storm event information may be obtained from a weather station that is representative of your location.

The SWPPP must explain how the person responsible for erosion control will be notified when stormwater runoff occurs. If weather conditions prevent correction of BMPs within 7 calendar days, the reasons for the delay must be documented (including pictures) and there must be a narrative explaining why the work cannot be accomplished within the 7 day time period. The documentation must be filed with the regular inspection reports. The permittee shall correct the problem as soon as weather conditions allow.

A log of each inspection and a current copy, of all the inspection reports shall be kept at the site or at an easily accessible location so that it can be made available at the time of an on-site inspection or at the request of the Department. The inspection report shall be signed by the permittee or by the person performing the inspection if duly authorized to do so. The inspection report is to include the following minimum information:
 - a. Inspector's name;
 - b. Date of inspection;
 - c. Observations relative to the effectiveness of the BMPs;
 - d. Actions taken or necessary to correct the observed problem; and
 - e. Listing of areas where land disturbance operations have permanently or temporarily stopped.
14. Proper Operation and Maintenance: The permittee shall at all times maintain all pollution control measures and systems in good order to achieve compliance with the terms of this general permit.
15. Notification to All Contractors: The permittee shall be responsible for notifying each contractor or entity (including utility crews and city employees or their agents) that will perform work at the site of the existence of the SWPPP and what action or precautions shall be taken while on-site to minimize the potential for erosion and the potential for damaging any BMP. The permittee is responsible for any damage a subcontractor may do to established BMPs and any subsequent water quality violation resulting from the damage.

16. Public Notification: The permittee shall post a copy of the public notification sign described by the Department at the main entrance to the site. The public notification sign must be visible from the public road that provides access to the site's main entrance. An alternate location is acceptable provided the public can see it and it is noted in the SWPPP. The public notification sign must remain posted at the site until the permit has been terminated.

D. OTHER DISCHARGES

1. Hazardous Substance and Oil Spill Reporting: Refer to Section B, #14 of Part I of the Standard Conditions that accompany this permit.
2. Removed substances: Refer to Section B, #6 of Part I of the Standard Conditions that accompany this permit.
3. Change in discharge: In the event soil contamination or hazardous substances are discovered at the site during land disturbance activities, the permittee shall notify the Department's regional office by telephone as soon as practicable but no later than 24 hours after discovery. The permittee must also notify the Department's regional office in writing no later than 14 calendar days after discovery.

E. SAMPLING REQUIREMENTS AND EFFLUENT LIMITATIONS

1. Settleable Solids discharging from a stormwater outfall shall not exceed 2.5 ml/L per Standard Method 2540 F for storm events up to but not exceeding the local 2-year, 24-hour storm. The Settleable Solids limit does not apply during storm events that exceed the local 2-year, 24-hour storm.
2. The Department may require sampling and reporting as a result of illegal discharges, compliance issues, complaint investigations, or other such evidence of contamination from activities at the site. If such an action is needed, the Department will specify in writing any sampling requirements, including such information as location, extent and parameters.

F. RECORDS

1. The permittee shall retain copies of this general permit, the SWPPP and all amendments for the site named in the State Operating Permit, results of any monitoring and analysis and all site inspection records required by this general permit. The records shall be accessible during normal business hours. The records shall be retained for a period of at least three years from the date of the Letter of Termination.
2. The permittee shall provide a copy of the SWPPP to the Department, USEPA, or any local agency or government representative if they request a copy in the performance of their official duties.
3. The permittee shall ensure a copy of the SWPPP to those who are responsible for installation, operation, or maintenance of any BMP. The permittee, their representative, and/or the contractor(s) responsible for installation, operation and maintenance of the BMPs shall have a current copy of the SWPPP with them when on the project site.

G. LAND PURCHASE AND CHANGE OF OWNERSHIP

- 1: Federal and Missouri stormwater regulations [10 CSR 20-6.200] require a stormwater permit and erosion control measures for all land disturbances of one or more acres. These regulations also require a permit for less than one acre lots if the lot is part of a common plan of development or sale where that plan is at least one acre in size. If the permittee sells less than one acre of the permitted site to an entity for, commercial, industrial, or residential use, (unless sold to an individual for the purpose of building his/her own private residence and in accordance with No. 3 of this section) this land remains a part of the common sale and regulated by this permit. Therefore, the permittee is still responsible for erosion control on the sold property until termination of the permit.
2. If the permittee sells one or more acres of the permitted site to an entity, the new owner of the property must obtain a land disturbance permit for the purchased property. The original permittee must amend the SWPPP to show that the property (one acre or more) has been sold and therefore no longer under the original permit jurisdiction.
3. If the permittee has stabilized the less than one acre lot which is part of a larger common plan of development and the lot is sold to an individual for purposes of building his/her own private residence, the permittee is no longer responsible for erosion control on the lot.
4. Property of any size which is part of a larger common plan of development where the property has been stabilized and the original permit terminated will require application of a new land disturbance permit for any future land disturbance activity.
5. If the entire tract is sold to a single entity, then this permit shall be terminated when the new owner obtains a new land disturbance permit for the site.

H. TERMINATION

This permit may be terminated when the project is stabilized. The project is considered to be stabilized when perennial vegetation, pavement, buildings, or structures using permanent materials cover all areas that have been disturbed. With respect to areas that have been vegetated, vegetation cover shall be at least 70% plant density over 100% of the site. In order to terminate the permit, the permittee shall notify the Department.

The Cover Page (Certificate Page) of the Master General Permit for Land Disturbance specifies the "effective date" and the "expiration date" of the Master General Permit. The "issued date" along with the "expiration date" will appear on the State Operating Permit issued to the applicant. This permit does not continue administratively beyond the expiration date.

If the project or development completion date will be after the expiration date of this general permit, then the permittee must reapply to the Department for a new permit. The applicant must file a request to the Department for a new permit 180 days prior to the expiration of this permit.

If the permittee has not terminated the permit and the permit expires, and the permittee has not applied for a new permit the permittee will be consider "operating without a permit" if the site does not meet the requirements for termination.

I. MODIFICATION, REVOCATION, AND REOPENING

1. The U.S. Environmental Protection Agency (EPA) has proposed stormwater requirements that may direct the State to reopen this permit. The EPA is proposing to change its construction general permit (CGP) with more prescriptive requirements and design standards for buffers to prevent stormwater runoff, increased monitoring requirements and more frequent inspections. While the EPA permit is only effective in areas where EPA has permitting authority these requirements are likely to act as a template, setting a baseline for the agency's approval of state plans for permitting sites.
2. If at any time the Missouri Department of Natural Resources determines that the quality of waters of the state may be better protected by reopening this permit, or revoking this permit and requiring the owner/operator of the permitted site to apply for a site-specific permit, the Department may revoke a general permit and require any person to obtain such an operating permit as authorized by 10 CSR 20-6.010 (13) and 10 CSR 20-6.200(5).
3. If this permit is re-opened, modified or revoked pursuant to this Section, the permittee retains all rights under Chapter 536 and 644 Revised Statutes of Missouri upon the Department's reissuance of the permit as well as all other forms of administrative, judicial, and equitable relief available under law.

J. DUTY TO COMPLY

The permittee must comply with all conditions of this general permit. Any noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

**STANDARD CONDITIONS FOR NPDES PERMITS
ISSUED BY
THE MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION**

Revised
October 1, 1980

**PART I - GENERAL CONDITIONS
SECTION A - MONITORING AND REPORTING**

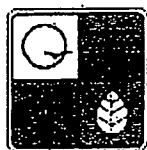
1. **Representative Sampling**
 - a. Samples and measurements taken as required herein shall be representative of the nature and volume, respectively, of the monitored discharge. All samples shall be taken at the outfall(s), and unless specified, before the effluent joins or is diluted by any other body of water or substance.
 - b. Monitoring results shall be recorded and reported on forms provided by the Department, postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the respective Department Regional Office, the Regional Office address is indicated in the cover letter transmitting the permit.
2. **Schedule of Compliance**
No later than fourteen (14) calendar days following each date identified in the "Schedule of Compliance", the permittee shall submit to the respective Department Regional Office as required therein, either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements, or if there are no more scheduled requirements, when such noncompliance will be corrected. The Regional Office address is indicated in the cover letter transmitting the permit.
3. **Definitions**
Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.
4. **Test Procedures**
Test procedures for the analysis of pollutant shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7015.
5. **Recording of Results**
 - a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
 - (i) the date, exact place, and time of sampling or measurements;
 - (ii) the individual(s) who performed the sampling or measurements;
 - (iii) the date(s) analyses were performed;
 - (iv) the individual(s) who performed the analyses;
 - (v) the analytical techniques or methods used; and
 - (vi) the results of such analyses.
 - b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than six (6) months per violation, or both.
 - c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.
6. **Additional Monitoring by Permittee**
If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

7. **Records Retention**

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recording for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

SECTION B - MANAGEMENT REQUIREMENTS

1. **Change in Discharge**
 - a. All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant not authorized by this permit or any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.
 - b. Any facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants shall be reported by submission of a new NPDES application at least sixty (60) days before each such change, or, if they will not violate the effluent limitations specified in the permit, by notice to the Department at least thirty (30) days before such changes.
2. **Noncompliance Notification**
 - a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such conditions:
 - (i) a description of the discharge and cause of noncompliance, and
 - (ii) the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.
 - b. Twenty-four hour reporting. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally with 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided with five (5) days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.
3. **Facilities Operation**
Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions. Operators or supervisors of operations at publicly owned or publicly regulated wastewater treatment facilities shall be certified in accordance with 10 CSR 209.020(2) and any other applicable law or regulation. Operators of other wastewater treatment facilities, water contaminant source or point sources, shall, upon request by the Department, demonstrate that wastewater treatment equipment and facilities are effectively operated and maintained by competent personnel.
4. **Adverse Impact**
The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any effluent limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.



Missouri
Department of
Natural Resources

STORMWATER DISCHARGES FROM
THIS LAND DISTURBANCE SITE ARE
AUTHORIZED BY THE MISSOURI STATE
OPERATING PERMIT NUMBER:

IF YOU HAVE QUESTIONS OR
CONCERNS ABOUT STORMWATER
DISCHARGES FROM THIS SITE, PLEASE
CONTACT THE MISSOURI
DEPARTMENT OF NATURAL
RESOURCES AT

1-800-361-4827

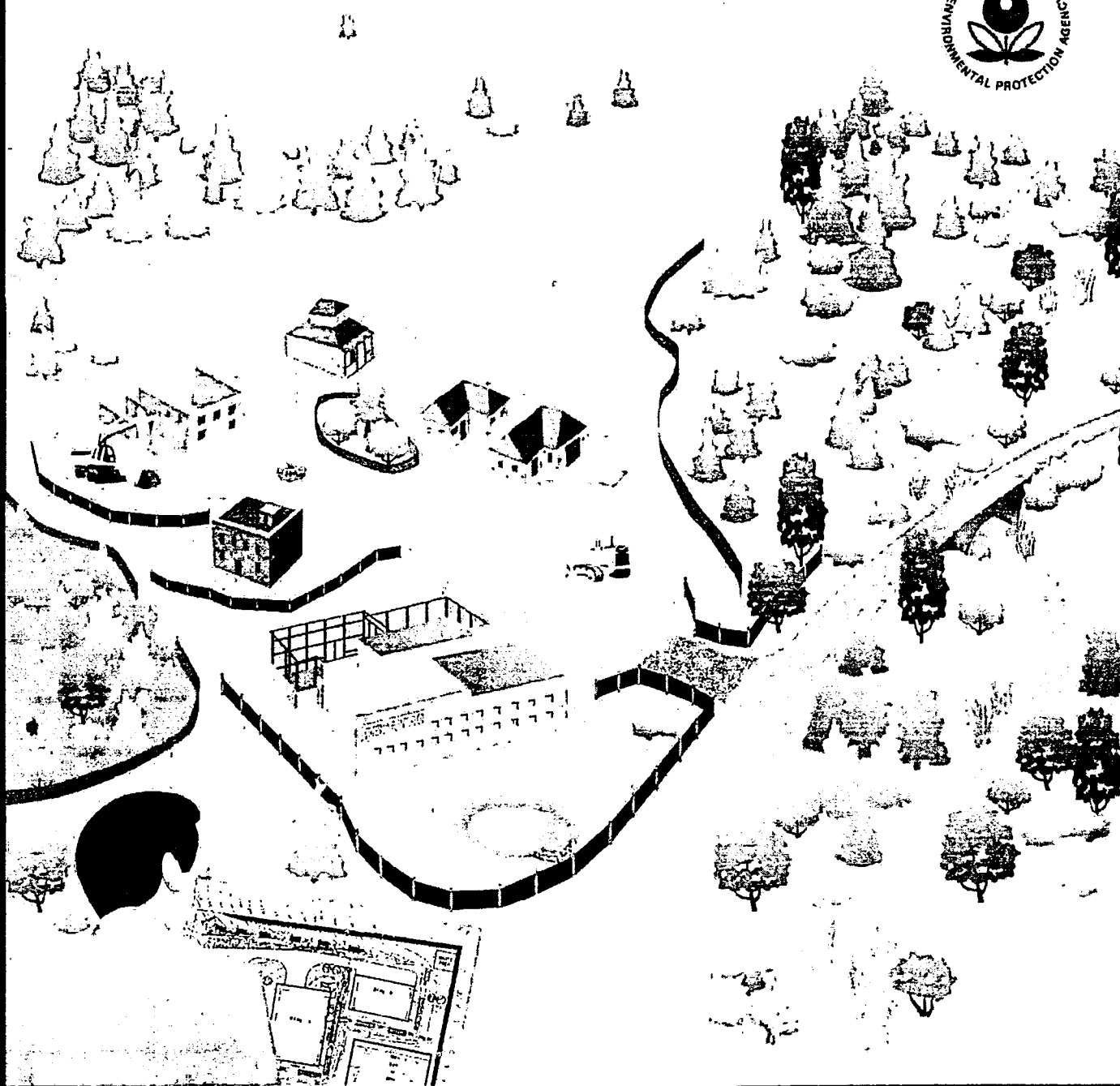
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Developing Your Stormwater Pollution Prevention Plan

A Guide for Construction Sites

EPA 833-R-060-04
May 2007



Developing Your Stormwater Pollution Prevention Plan

A Guide for Construction Sites

Who?

Construction site operators (generally, the person who has operational control over construction plans and/or the person who has day-to-day supervision and control of activities occurring at the construction site)

Where?

Construction sites required to comply with stormwater discharge requirements

What?

A guide to help you develop a good Stormwater Pollution Prevention Plan (SWPPP)

Why?

Stormwater runoff from construction sites can cause significant harm to our rivers, lakes, and coastal waters

A SWPPP is required (by your construction general permit) and will help you prevent stormwater pollution

A SWPPP is more than just a sediment and erosion control plan.

It describes all the construction site operator's activities to prevent stormwater contamination, control sedimentation and erosion, and comply with the requirements of the Clean Water Act

Purpose of this Guidance Document

This document provides guidance to construction site operators that need to prepare a SWPPP in order to receive NPDES permit coverage for their stormwater discharges. The Clean Water Act provisions, EPA regulations and EPA's Construction General Permit described in this document contain legally binding requirements. This document does not substitute for those provisions, regulations or permit, nor is it a regulation or permit itself. It also does not substitute for requirements under State law or construction general permits issued by States. It does not impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA and State decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. Any decisions regarding a particular construction site will be made based on the applicable statutes, regulations and/or permit terms. Therefore, interested parties are free to raise questions and objections about the appropriateness of the application of this guidance to a particular situation, and EPA—or the applicable NPDES permitting authority—will consider whether or not the recommendations or interpretations in the guidance are appropriate in that situation based on the law and regulations.

This guidance document occasionally uses language describing mandatory requirements for construction site operators and those covered by a general permit for stormwater discharges from such sites. This language is generally intended to reflect requirements applicable where EPA is the NPDES permitting authority. Although requirements in jurisdictions where EPA is not the permitting authority may resemble these requirements, the reader should not assume that this guidance accurately describes those requirements. Rather, the reader should consult the applicable regulations and any applicable NPDES permit.

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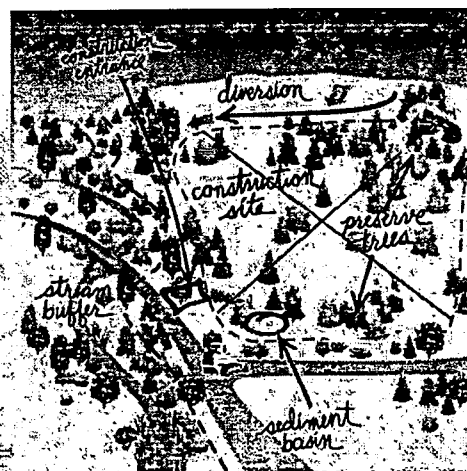
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What is a Stormwater Pollution Prevention Plan (SWPPP)?

A SWPPP may be called many things. Your state may use terms like:

- Construction Best Practices Plan
- Sediment and Stormwater Plan
- Erosion, Sediment, and Pollution Prevention Plan
- Construction Site Best Management Practices Plan
- Erosion Control Plan and Best Management Practices
- Best Management Practices Plan
- Erosion and Sediment Control Plan

Regardless of the title used in your state, these documents—and the stormwater permits that require them—tend to have many common elements. This guide is intended to help you develop a better SWPPP for your construction site.



Example sketch identifying various points to address in the SWPPP.

How to Use This Guide

- This guide was developed as a helpful reference guide for construction site operators across the country. We have tried to accommodate the wide range of knowledge and experience about stormwater pollution prevention that currently exists among operators—from novice to expert.
 - If you are relatively new to managing stormwater at a construction site, you will probably want to read this entire guide.
 - If you are very experienced and familiar with the requirements in your state, this guide may help you brush up on certain requirements or provide you with ideas to improve your SWPPP. You might want to review the table of contents and skip around. Be sure to take a look at the SWPPP template (Appendix A) to see if you can make improvements in the way you develop and maintain your SWPPP.
- This guide is written in a general format and can be used at most construction sites in any state, territory, or in Indian country. The document assumes that you will obtain discharge authorization under an appropriate National Pollutant Discharge Elimination System (NPDES) construction general permit and use both the permit and this guidance to assist in developing your SWPPP. In this guide, we make some references to the U.S. Environmental Protection Agency's Construction General Permit for illustrative purposes. **You should always consult your applicable NPDES permit for the exact requirements that apply to you.**
- Remember that you are developing your SWPPP for both your use and for review by the regulatory agencies responsible for overseeing your stormwater controls. As such, one of your goals in developing your SWPPP should be to present the information in a way that clearly demonstrates that it meets all the requirements of your NPDES permit.
- You can obtain an electronic copy of this guide (PDF format), the SWPPP template, and inspection form (in Microsoft Word) at www.epa.gov/npdes/swpppguide

Chapter 1: Introduction

► This chapter provides an orientation to this guide and its contents and describes why stormwater controls at construction sites are necessary.

A. Why Should You Use this Guide?

If you are responsible for erosion and sediment control and stormwater management at a permitted construction site, then this guide may be useful to you. This guide is designed to walk you through the steps for developing and implementing an effective stormwater pollution prevention plan (SWPPP). The basic outline of the guide is presented below:

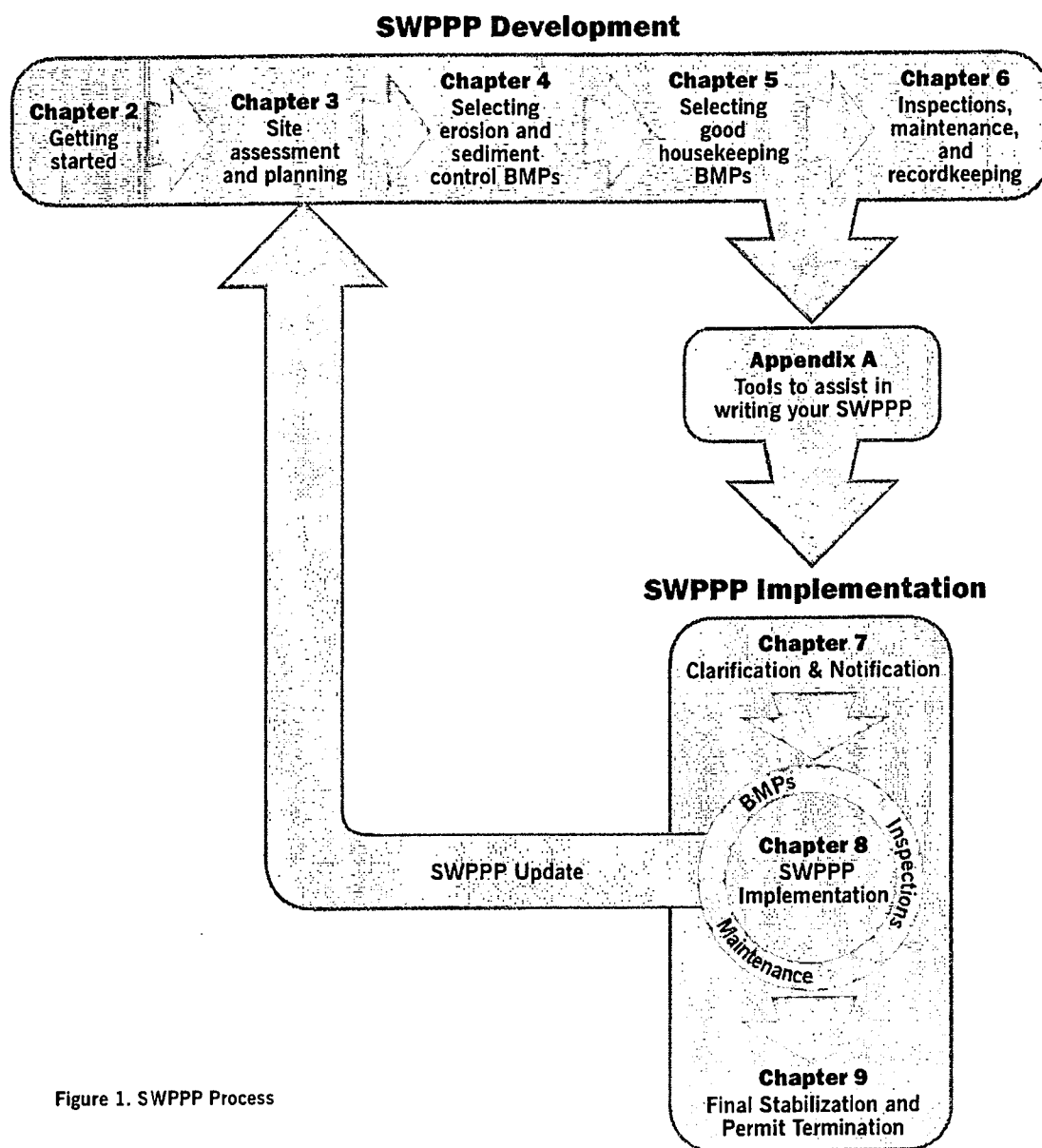


Figure 1. SWPPP Process

Take a Closer Look...

What is a SWPPP?

A SWPPP is a site-specific, written document that:

- Identifies potential sources of stormwater pollution at the construction site
- Describes practices to reduce pollutants in stormwater discharges from the construction site. Reduction of pollutants is often achieved by controlling the volume of stormwater runoff (e.g., taking steps to allow stormwater to infiltrate into the soil).
- Identifies procedures the operator will implement to comply with the terms and conditions of a construction general permit

What does this mean to me?

Failure to implement your SWPPP could result in significant fines from EPA or a state environmental agency. Therefore, it is important that you develop your SWPPP to address the specific conditions at your site, fully implement it, and keep it up-to-date to reflect changes at your site.

B. What Is Stormwater Runoff and What Are Its Impacts?

Stormwater runoff is rain or snowmelt that flows over land and does not percolate into the soil. Stormwater runoff occurs naturally, in small amounts, from almost any type of land surface, especially during larger storm events.

SWPPP Tip!

A SWPPP can have different names

A SWPPP may also be called a "construction best practices plan," "sediment and stormwater plan," "erosion, sedimentation, and pollution prevention plan," or similar term. The SWPPP (or similarly named plan) is generally required to comply with EPA's or the state's stormwater construction general permit.

Impervious surfaces, such as buildings, homes, roads, sidewalks, and parking lots, can significantly alter the natural hydrology of the land by

increasing the volume, velocity, and temperature of runoff and by decreasing its infiltration capacity. Increasing the volume and velocity of stormwater runoff can cause severe stream bank erosion, flooding, and degrade the biological habitat of these streams. Reducing infiltration can lower ground water levels and affect drinking water supplies.

In addition, as stormwater runoff moves across surfaces, it picks up trash, debris, and pollutants such as sediment, oil and grease, pesticides and other toxics. Changes in ambient water temperature, sediment, and pollutants from stormwater runoff can be detrimental to aquatic life, wildlife, habitat, and human health. Soil exposed by construction activities is especially vulnerable to erosion. Runoff from an unstabilized construction site can result in the loss of approximately 35–45 tons of sediment per acre each year (ASCE and WFF, 1992). Even during a short period of time, construction sites can contribute more sediment to streams than would be deposited naturally over several

decades. Excess sediment can cloud the water reducing the amount of sunlight reaching aquatic plants, clog fish gills, smother aquatic habitat and spawning areas, and impede navigation in our waterways.

The primary stormwater pollutant at a construction site is sediment. To control erosion at a construction site, it is important to understand the different types of erosion that can occur. Erosion begins when raindrops break down the soil structure and dislodge soil particles. Runoff carrying the soil particles becomes sheet erosion which eventually forms smaller rills and larger gullies. The best way to stop erosion is to keep the soil in place through vegetation, erosion control blankets, or other methods that prevent the soil from becoming dislodged during rain events.

The erosion process is typically influenced by climate, topography, soils, and vegetative cover. Understanding how these factors influence erosion will help you select and design appropriate controls to minimize erosion from your construction site.

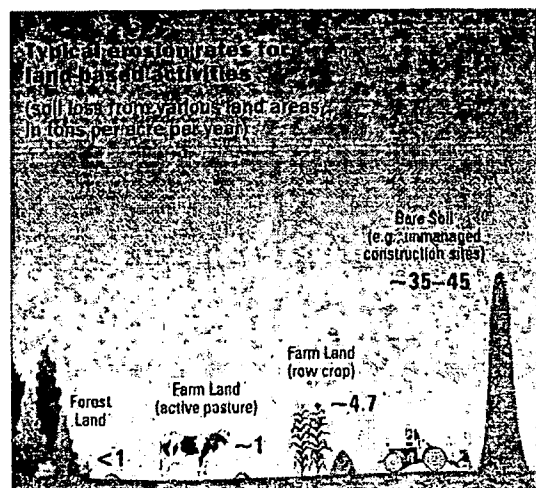


Figure 2. Typical erosion rates from land-based activities. (Dunne, T. and L. Leopold, 1978; NRCS, 2000; NRCS, 2006; ASCE and WEF, 1992)

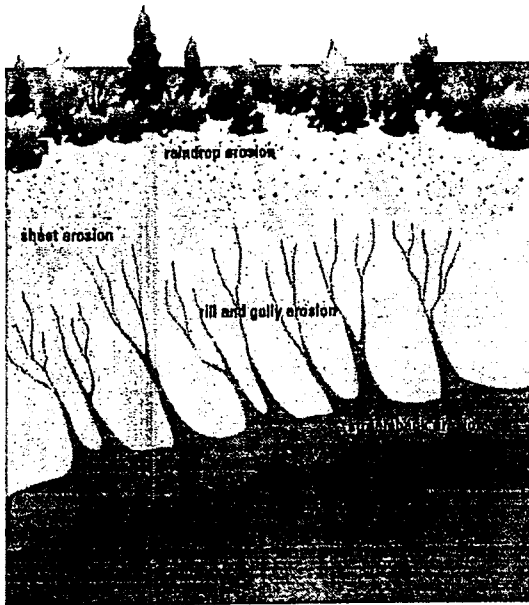


Figure 3. Types of erosion.

Raindrop erosion

Dislodging of soil particles by raindrops

Sheet erosion

The uniform removal of soil without the development of visible water channels

Rill erosion

Soil removal through the formation of concentrated runoff that creates many small channels

Gully erosion

The result of highly concentrated runoff that cuts down into the soil along the line of flow

Streambank erosion

Flowing water that erodes unstable streambanks

Climate. The frequency, intensity, and duration of rainfall are the principal factors influencing erosion from a construction site. Know the weather patterns in your area and, if possible, plan your soil disturbance activities for periods of historically lower rainfall.

Topography. The longer and steeper a slope, the greater the potential there is for erosion from that slope. Use practices such as diversions or fiber rolls to break up long slopes. Consider minimizing soil disturbance activities on steeper slopes.

Soils. Soil type can also impact erosion. Soil texture, structure, organic matter content, compaction, and permeability can all influence erosion rates.

Vegetative cover. Vegetative cover provides a number of critical benefits in preventing erosion—it absorbs the energy of raindrops, slows velocity of runoff, increases infiltration, and helps bind the soil. Soil erosion can be greatly reduced by maximizing vegetative cover at a construction site.

C. How Can Construction Site Operators Prevent Stormwater Pollution?

An effective SWPPP is the key! If sediment and erosion controls and good housekeeping practices are not followed, construction activity can result in the discharge of significant amounts of sediment and other pollutants. The term *Best Management Practices* or BMPs is often used to describe the controls and activities used to prevent stormwater pollution.

SWPPP Tip!

Erosion versus Sedimentation

Erosion is the process by which the land surface is worn away by the action of water or wind.

Sedimentation is the movement and settling out of suspension of soil particles. It is usually easier and less expensive to prevent erosion than it is to control sediment from leaving a construction site.

BMPs can be divided into two categories—structural and non-structural BMPs. Structural BMPs include silt fences, sedimentation ponds, erosion control blankets, and temporary or permanent seeding, while non-structural BMPs include picking up trash and debris, sweeping up nearby sidewalks and streets, maintaining equipment, and training site staff on erosion and sediment control practices. In this document, the term “BMPs” is used broadly and includes both structural and non-structural controls and practices.

A SWPPP is more than just a sediment and erosion control plan. Most SWPPPs are written documents that describe the pollution prevention practices and activities that will be implemented on the site. It includes descriptions of the site and of each major phase of the planned activity, the roles and responsibilities of contractors and subcontractors, and the inspection schedules and logs. It is also a place to document changes and modifications to the construction plans and associated stormwater pollution prevention activities.

Chapter 2: Getting Started

A. What Are the Federal Requirements for Stormwater Runoff from Construction Sites?

The Clean Water Act and associated federal regulations (Title 40 of the *Code of Federal Regulations* [CFR] 123.25(a)(9), 122.26(a), 122.26(b)(14)(x) and 122.26(b)(15)) require nearly all construction site operators engaged in clearing, grading, and excavating activities that disturb one acre or more, including smaller sites in a larger common plan of development or sale, to obtain coverage under a National Pollutant Discharge Elimination System (NPDES) permit for their stormwater discharges. Under the NPDES program, the U.S. Environmental Protection Agency (EPA) can authorize states to implement the federal requirements and issue stormwater permits. Today, most states are authorized to implement the NPDES program and issue their own permits for stormwater discharges associated with construction activities.

SWPPP Tip!

Don't forget about "common plans of development or sale"

A common plan of development or sale includes larger-scale plans for land development to be carried out by one or more entities. Examples include housing developments and subdivisions, industrial parks, and commercial developments.

EPA has described this term in the fact sheet accompanying its Construction General Permit as including: any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.), or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating construction activities may occur on a specific plot. Each permitting authority may review documentation to determine if common plan requirements apply.

Each state (or EPA, in the case of states that are not authorized) issues one or more NPDES construction general permits. These permits, generally, can be thought of as umbrella permits that cover all stormwater discharges associated with construction activity in a given state for a designated time period, usually 5 years. Operators of individual construction sites then apply for coverage under this permit. *Before applying for permit coverage, you should read and understand all the provisions of the appropriate construction general permit and develop a SWPPP.* Because authorized states develop their own NPDES requirements, you should carefully read your state's construction general permit and follow the specific instructions it contains.

► This chapter describes some of the basic things you'll want to determine (Do you need permit coverage? What permit applies to you?), as well as some of the materials and information you may need to develop your SWPPP. Collecting this information before you start will help you develop your SWPPP more efficiently. Keep in mind that you may also need to gather this information and develop your SWPPP before you complete your Notice of Intent (NOI) and file for permit coverage (note that filing an NOI is not discussed until Chapter 7).

Take a Closer Look...

EPA Permits vs. State-Issued Permits

At the time of publication, EPA was the NPDES permitting authority in Massachusetts, New Hampshire, New Mexico, Idaho, Alaska, the District of Columbia, Puerto Rico, the U.S. territories (except the Virgin Islands), most Indian country lands, and for federal facilities in four states. For an up-to-date list of NPDES permitting authorities, visit www.epa.gov/npdes/stormwater/construction or www.cicacenter.org/swrl.html

What does this mean to me?

Because EPA and state-issued permits can be different, you should make sure you read and apply for the correct permit. Use the links on either of the web sites listed to the left to determine which agency issues NPDES permits where your construction activity will occur.

Most construction general permits contain similar elements:

- **Applicability**—describes the geographic area covered and who is eligible to apply
- **Authorization**—describes the types of stormwater (and non-stormwater) discharges that are covered
- **SWPPP requirements**—outlines the elements that should be addressed to prevent the contamination of stormwater runoff leaving the construction site
- **Application**—includes instructions for obtaining permit coverage, usually by filing an application or Notice of Intent (NOI) form
- **Implementation**—BMP installation, inspection, and maintenance requirements
- **Other requirements**—may include additional requirements such as spill prevention
- **Standard conditions**—list of conditions that are applicable to most NPDES permits
- **Termination**—lists conditions for terminating permit coverage after construction is complete

What Construction Activities Require NPDES Permit Coverage?

In this document, “*construction*” refers to actions that result in a disturbance of the land, including clearing, grading, excavating, and other similar activities. It also includes “*construction-related activities*,” areas that support the construction project such as stockpiles, borrow areas, concrete truck washouts, fueling areas, material storage areas and equipment storage areas.

Construction activities that do not disturb land, such as interior remodeling, generally do not require NPDES permit coverage.

Are There Situations Where a Permit Is Not Needed?

Generally, permit coverage is not required for activities that are considered routine maintenance, such as landscaping, road maintenance, and maintaining stormwater BMPs. Some states and EPA offer the option of a waiver for small sites (disturbing less than 5 acres) in areas and times of the year with low predicted rainfall. To be eligible for the waiver, you would have to meet the requirements specified in the regulations.

Local Requirements

Operators of construction sites should keep in mind that local governments (cities, towns, counties) often have their own requirements for construction sites (e.g., local permits for grading, sediment and erosion, utilities).

Compliance with local requirements does not mean compliance with federal NPDES requirements or vice versa, unless the authorized state agency or EPA has specifically designated the local program a qualifying local program.

Qualifying Local Programs

In some states, the NPDES permitting agency has identified certain local construction stormwater control programs that have requirements that are equivalent or more protective than the state’s requirements. If one of these local stormwater programs has been designated by the permitting agency as a *qualifying local program*, the construction site operator may simply read and follow the local requirements. The permitting agency (state or EPA) might choose to waive the requirement to file a Notice of Intent (NOI) or similar application form for small construction sites operating within the jurisdiction of a qualifying local program. If waived, these sites would be covered under the appropriate construction general permit automatically. Check your construction general permit carefully.

The NPDES permitting authority must identify any qualifying local programs in the construction general permit. Violations of the local requirements are also considered violations of the NPDES requirements and may be enforced accordingly.

SWPPP Tip!

Read Your General Permit!

You should thoroughly read and understand the requirements in your general permit. This includes requirements on eligibility (whether your site qualifies for the general permit), application (how to notify EPA or the state that you’d like to be covered by the general permit), SWPPPs, and termination (stabilizing your site and notifying EPA or the state that your project is complete). By applying for coverage under the general permit, you are telling EPA or your state that you will comply with the permit’s requirements, so read your permit carefully!

B. Who Is Required to Get NPDES Permit Coverage?

Construction site *operators* are responsible for obtaining NPDES permit coverage for their stormwater discharges. Each state has its own definition of the term *operator*. Operators may include owners (e.g., developers), general contractors, independent subcontractors, government officials, companies, or corporations. This section reflects EPA's understanding of most NPDES permit requirements for stormwater discharges throughout the country. You should, of course, consult your construction general permit for the requirements that apply to you. In some cases, states have defined the operator as a single entity, usually the land owner or easement holder. In other states, several entities may meet the definition of operator. For instance, the owner may control the project's plans and specifications, and the general contractor may control the site's day-to-day operations. In such cases, both may be defined as operators. If a site has multiple operators, they may cooperate on the development and implementation of a single SWPPP. Operators generally obtain coverage under an NPDES permit, often by filing a form called a Notice of Intent (NOI).



Figure 4. Use signage to help educate construction staff.

EPA's Construction General Permit (which applies only where EPA is the permitting authority—see Chapter 2 Section A) defines operator as any party that:

- Has control over the construction plans and specifications
and/or
- Has day-to-day operational control of the site, including activities necessary to implement the SWPPP

Regardless of whether or not the operator is a corporation or governmental entity, someone must direct the SWPPP's preparation and implementation and apply for NPDES permit coverage for the stormwater discharges. In most cases, this will be a high-level official, such as a corporate officer, manager or elected official, or a principal executive officer. For specific instructions, refer to the appropriate NPDES stormwater permit.

Multiple Operators

In many instances, there may be more than one party at a site performing tasks related to *operational control* and more than one operator may need to submit an NOI. Depending on the site and the relationship between the parties (e.g., owner, developer, general contractor), there can either be a single party acting as site operator and consequently responsible for obtaining permit coverage, or there can be two or more operators all needing permit coverage. Exactly who is considered an operator is largely controlled by how the *owner* of the project chooses to structure the contracts with the *contractors* hired to design and/or build the project. The following are three general operator scenarios (variations on any of these three are possible, especially as the number of owners and contractors increases):

- *Owner as sole permittee.* The property owner designs the structures for the site, develops and implements the SWPPP, and serves as general contractor (or has an on-site representative with full authority to direct day-to-day operations). The owner may be the only party that needs permit coverage under these circumstances. Everyone else on the site may be considered subcontractors and might not need permit coverage.

- **Contractor as sole permittee.** The property owner hires one company (i.e., a contractor) to design the project and oversee all aspects of the construction project, including preparation and implementation of the SWPPP and compliance with the permit (e.g., a *turnkey* project). Here, the contractor would likely be the only party needing a permit. It is under this scenario that an individual having a personal residence built for his own use (e.g., not those to be sold for profit or used as rental property) would not be considered an operator. However, individual property owners would meet the definition of *operator* and may require permit coverage if they perform general contracting duties for construction of their personal residences.
- **Owner and contractor as co-permittees.** The owner retains control over any changes to site plans, SWPPPs, or stormwater conveyance or control designs; but the contractor is responsible for overseeing actual earth disturbing activities and daily implementation of SWPPP and other permit conditions. In this case, which is the most common scenario, both parties may need to apply for permit coverage.

However, you are probably not an operator and subsequently would not need permit coverage if one of the following is true:

- You are a subcontractor hired by, and under the supervision of, the owner or a general contractor (i.e., if the contractor directs your activities on-site, you probably are not an operator)
- The operator of the site has indicated in the SWPPP that someone other than you (or your subcontractor) is responsible for your activities as they relate to stormwater quality (i.e., another operator has assumed responsibility for the impacts of your

construction activities). This is typically the case for many, if not most, utility service line installations.

In addition, *owner* typically refers to the party that owns the structure being built. Ownership of the land where construction is occurring does not necessarily imply the property owner is an operator (e.g., a landowner whose property is being disturbed by construction of a gas pipeline). Likewise, if the erection of a structure has been contracted for, but possession of the title or lease to the land or structure does not occur until after construction, the would-be owner may not be considered an operator (e.g., having a house built by a residential homebuilder).

Transferring Ownership

In many residential developments, an overall developer applies for the stormwater permit coverage, conducts grading activities, and installs the basic infrastructure (e.g., utilities, roads). Individual lots are then sold to builders who then construct the houses. Unless the developer is still responsible for stormwater on these individual lots (which is typically not the case), it is likely that the builder will need to apply for NPDES permit coverage for stormwater discharges during home construction.

Subcontractors

It is typically a good idea to include specific contract language requiring subcontractors to implement appropriate stormwater controls. Subcontractors should be trained on appropriate BMPs and requirements in the SWPPP and should not disturb or remove BMPs. Some contractors will include specific penalties in subcontractor agreements to ensure subcontractors do not damage or remove BMPs.

Take a Closer Look...

Erosion Control vs. Sediment Control

When developing a SWPPP, it is important to understand the difference between erosion control and sediment control. Erosion control measures (e.g., mulch, blankets, mats, vegetative cover) protect the soil surface and prevent soil particles from being dislodged and carried away by wind or water. Sediment control measures remove soil particles after they have been dislodged (typically through settling or filtration). It is usually easier and less expensive to prevent erosion than it is to control sedimentation.

What does this mean to me?

You should try to use erosion control BMPs as the primary means of preventing stormwater contamination, and sediment control techniques to capture any soil that does get eroded. Because no one technique is 100 percent effective, a good SWPPP will use both kinds of BMPs in combination for the best results.

C. What Elements Are Required in a SWPPP?

The SWPPP lays out the steps and techniques you will use to reduce pollutants in stormwater runoff leaving your construction site. Therefore, proper development and implementation of your SWPPP is crucial. First and foremost, your SWPPP must be developed and implemented consistent with the requirements of the applicable NPDES stormwater construction permit. The following discussion describes requirements that are contained in most of these permits.

Your SWPPP is used to identify all potential pollution sources that could come into contact with stormwater leaving your site. It describes the BMPs you will use to reduce pollutants in your construction site's stormwater discharges, and it includes written records of your site inspections and the follow-up maintenance that is performed.

Your SWPPP should contain the following elements:

- Cover/title page
- Project and SWPPP contact information
- Site and activity description, including a site map
- Identification of potential pollutant sources
- Description of controls to reduce pollutants
- Maintenance/inspection procedures
- Records of inspections and follow-up maintenance of BMPs
- SWPPP amendments
- SWPPP certification

Chapters 3–6 of this guide describe how to develop a SWPPP—from site evaluation and data collection to selecting appropriate BMPs and assigning maintenance and inspection responsibilities.

D. SWPPP Roles and Responsibilities

The operator has the lead for developing and implementing the SWPPP and committing resources to implement the BMPs. Stormwater pollution control is typically the job of more than a single person; the SWPPP development process provides a good opportunity to define roles and responsibilities of everyone involved. Roles and responsibilities are to be documented clearly in the SWPPP and subcontractor agreements as necessary. Your SWPPP should describe:

- Who is on the stormwater pollution prevention team?
- Who will install structural stormwater controls?
- Who will supervise and implement good housekeeping programs, such as site cleanup and disposal of trash and debris, hazardous material management and disposal, vehicle and equipment maintenance, and so on?
- Who will conduct routine inspections of the site to ensure all BMPs are being implemented and maintained?
- Who will maintain the BMPs?
- Who is responsible for documenting changes to the SWPPP?
- Who is responsible for communicating changes in the SWPPP to people working on the site?

When you apply for your stormwater permit, the application may ask for a SWPPP contact. This could be the construction site operator, but in many cases it's a staff person (e.g., project superintendent, field manager, construction manager, stormwater compliance officer) at the construction site who is responsible for conducting inspections, ensuring BMPs are installed and maintained, and updating the SWPPP when necessary.

SWPPP Tip!

Erosion Control Certification

Several programs promote the training and certification of individuals in erosion and sediment control. Some states have developed certification programs and require construction sites to have a certified individual on-site at all times. The Soil and Water Conservation Society and the International Erosion Control Association sponsor a national certification program, the Certified Professional in Erosion and Sediment Control (www.cpesc.org)

E. Common SWPPP Objectives

The SWPPP outlines the steps you will take to comply with the terms and conditions of your construction general permit. Keeping the following objectives in mind as you develop your SWPPP will help guide you in addressing your permit requirements and in protecting water quality.

- *Stabilize the site as soon as possible.* Get your site to final grade and either permanently or temporarily stabilize all bare soil areas as soon as possible. Take into consideration germination times for the grasses or other vegetation selected, and provide additional stabilization (mulches, matrices, blankets, soil binders) on erosion-prone areas such as slopes and drainage ways. Also consider seasonal limitations to plant establishment and growth, such as drought or cold temperatures, and make an effort to ensure that areas that are not showing adequate vegetation establishment are reseeded or mulched immediately. Areas needed for future roads, construction, or other purposes should be temporarily stabilized (see your permit for requirements related to areas of the site not currently under active construction). Establishing a vegetated cover on as much of the site as possible will help to minimize erosion and sediment problems. Perimeter controls should remain in place until final stabilization has been achieved.
- *Protect slopes and channels.* Convey concentrated stormwater runoff around the top of slopes and stabilize slopes as soon as possible. This can be accomplished using pipe slope drains or earthen berms that will convey runoff around the exposed slope. Avoid disturbing natural channels and the vegetation along natural channels, if possible.
- *Reduce impervious surfaces and promote infiltration.* Reducing impervious surfaces will ultimately reduce the amount of runoff leaving your site. Also, divert runoff from rooftops and other impervious surfaces to vegetated areas when possible to promote infiltration.
- *Control the perimeter of your site.* Divert stormwater coming on to your site by conveying it safely around, through, or under your site. Avoid allowing run-on to contact disturbed areas of the construction site. For the runoff from the disturbed areas of the site, install BMPs such as silt fences to capture sediment before it leaves your site. Remember—"Divert the clean water, trap the dirty water."
- *Protect receiving waters adjacent to your site.* Erosion and sediment controls are used around the entire site, but operators should consider additional controls on areas that are adjacent to receiving waters or other environmentally sensitive areas. **Remember, the primary purpose of erosion and sediment controls is to protect surface waters.**
- *Follow pollution prevention measures.* Provide proper containers for waste and garbage at your site. Store hazardous materials and chemicals so that they are not exposed to stormwater.
- *Minimize the area and duration of exposed soils.* Clearing only land that will be under construction in the near future, a practice known as construction phasing, can reduce off-site sediment loads by 36 percent for a typical subdivision (Claytor 2000). Additionally, minimizing the duration of soil exposure by stabilizing soils quickly can reduce erosion dramatically.

Take a Closer Look...

Incentives to preserve open space

It should be the goal of every construction project to, where possible, preserve open space and minimize impervious surfaces through practices such as clustering houses.

Open space preservation can provide significant water quality and economic benefits to property owners.

What does this mean to me?

From a marketing perspective, studies have shown that lots abutting forested or other open space are initially valued higher than lots with no adjacent open space, and over time their value appreciates more than lots in conventional subdivisions (Arendt 1996). For example, lots in an open space subdivision in Amherst, Massachusetts, experienced a 13 percent greater appreciation in value over a comparable conventional development after 20 years even though the lots in the conventional development were twice as large (Arendt 1996).

Chapter 3: SWPPP Development—Site Assessment and Planning

► The first step in developing a SWPPP is assessing the site and identifying measures to protect natural features.

This chapter describes a number of steps that will help provide a good foundation for your SWPPP, including:

- Assessing current conditions at the site
- Establishing pollution prevention and water quality protection goals for your project
- Developing a framework to help you meet those goals

A. Assess Your Site and Proposed Project

The first step in developing your SWPPP is to evaluate your proposed construction site. Your SWPPP should describe the undeveloped site and identify features of the land that can be incorporated into the final plan and natural resources that should be protected. Understanding the hydrologic and other natural features of your site will help you develop a better SWPPP and, ultimately, to more effectively prevent stormwater pollution.

Visit the Site

The people responsible for site design and drafting the SWPPP should conduct a thorough walk-through of the entire construction site to assess site-specific conditions such as soil types, drainage patterns, existing vegetation, and topography. Avoid copying SWPPPs from other projects to save time or money. Each construction project and SWPPP is unique, and visiting the site is the only way to create a SWPPP that addresses the unique conditions at that site.

Assess Existing Construction Site Conditions

Assess the existing conditions at the construction site, including topography, drainage, and soil type. This assessment, sometimes called *fingerprinting* (see text box on page 11) is the foundation for building your SWPPP and for developing your final site plan. In this assessment, use or create a topographic drawing that:

- Indicates how stormwater currently drains from the site, and identify the location of discharge points or areas
- Identifies slopes and slope lengths. The topographic features of the site are a major factor affecting erosion from the site
- Identifies soil type(s) and any highly erodible soils and the soil's infiltration capacity
- Identifies any past soil contamination at the site
- Identifies natural features, including trees, streams, wetlands, slopes and other features to be protected

SWPPP Tip!

A SWPPP is a detailed plan that:

- Identifies potential sources of stormwater pollution
- Describes the practices that will be used to prevent stormwater pollution. These should include: erosion and sediment control practices, good housekeeping practices, conservation techniques, and infiltration practices (where appropriate), and
- Identifies procedures the operator will implement to comply with all requirements in the construction general permit

Take a Closer Look...

Fingerprinting Your Site

When you evaluate your construction site, you should clearly identify vegetation, trees, and sensitive areas, such as stream buffers, wetlands, highly erodible soils, and steep slopes at your site. You should protect these areas from disturbance. Inventorying a site's natural features is a technique called fingerprinting. Fingerprinting identifies natural features that you can protect from clearing and heavy equipment by signage or physical barriers.

What does this mean to me?

Fingerprinting your site will help ensure that you don't damage natural features such as waterways or wetlands. Conducting construction activity in a waterway or wetland without the proper permits can result in significant penalties.

In most cases, the site designer can compile all this information on a digitized drawing that can then be adapted to show the planned construction activity, the phases of construction, and the final site plan.

Topographic maps are readily available on the Internet (e.g., www.terraserver.com or www.mapquest.com) or by contacting the U.S. Geological Survey store (<http://store.usgs.gov>). If you need help determining your soil type, contact your local Natural Resource Conservation Service (NRCS) office or extension service office. To find the NRCS office nearest to your site, visit the U.S. Department of Agriculture's Service Center Locator website (<http://offices.sc.egov.usda.gov/locator/app>). Soil information is also available online from NRCS (<http://soils.usda.gov>).

Identify Receiving Waters, Storm Drains, and Other Stormwater Conveyance Systems

Your SWPPP should clearly identify the receiving waters and stormwater systems through which stormwater from your site could flow. Many states require planning for a specific storm event or storm events. These storm events are referred to by their recurrence interval and duration such as 1-year, 6-hour storm or a 100-year, 24-hour storm. These events then translate into a specific rainfall amount depending on average conditions in your area.

If your site's stormwater flows into a municipal storm drain system, you should determine the ultimate destination of that system's discharge. This may be obvious and easy to document. However, in some systems, you may have to consult with the local agency

responsible for the storm drain system to determine the waterbody to which you are discharging.

If your site's stormwater runs off to areas not connected to the storm drain system, you should consider your land's topography and then identify the waterbodies that it could reach. Many sites will discharge some stormwater to a storm drain system and some to other areas not connected to the system. If your site's stormwater could potentially reach two or more waterbodies, note that in your SWPPP. Remember, stormwater can travel long distances over roads, parking lots, down slopes, across fields, and through storm sewers and drainage ditches.

Describe Your Construction Project

Your SWPPP should contain a brief description of the construction activity, including:

- Project type or function (for example, low-density residential, shopping mall, highway)
- Project location, including latitude and longitude
- Estimated project start and end dates
- Sequence and timing of activities that will disturb soils at the site
- Size of the project
- Estimated total area expected to be disturbed by excavation, grading, or other construction activities, including dedicated off-site borrow and fill areas
- Percentage of impervious area before and after construction

Construction Site Pollutants									
Areas of Consideration	Primary Pollutant	Other Pollutants							
	Sediment	Nutrients	Heavy metals	pH (acids & bases)	Pesticides & herbicides	Oil & grease	Bacteria & viruses	Trash, debris, solids	Other toxic chemicals
Clearing, grading, excavating, and unstabilized areas	✓							✓	
Paving operations	✓							✓	
Concrete washout and waste			✓	✓				✓	
Structure construction/painting/cleaning		✓		✓				✓	✓
Demolition and debris disposal	✓							✓	
Dewatering operations	✓	✓							
Drilling and blasting operations	✓			✓				✓	
Material delivery and storage	✓	✓	✓	✓	✓	✓		✓	✓
Material use during building process		✓	✓	✓	✓	✓		✓	✓
Solid waste (trash and debris)								✓	✓
Hazardous waste			✓	✓	✓	✓			✓
Contaminated spills		✓	✓	✓	✓	✓			✓
Sanitary/septic waste		✓		✓			✓		✓
Vehicle/equipment fueling and maintenance						✓			✓
Vehicle/equipment use and storage						✓			✓
Landscaping operations	✓	✓						✓	

- Runoff coefficient¹ before and after construction
- Soil types
- Construction site location and any nearby waters or wetlands
- Describe and identify the location of other potential sources of stormwater contamination, such as asphalt and concrete plants, stucco operations, paint and concrete washout, and such

Identify Pollutants and Pollution Sources

Identify the pollutants and sources that are likely to be found on the site. The principle pollutant of concern, of course, is sediment. There are, however, other pollutants that may be found, usually in substantially smaller amounts, in stormwater runoff from construction sites. These can include nutrients, heavy metals, organic compounds, pesticides, oil and grease, bacteria and viruses, trash and debris, and other chemicals. After identifying the pollutants and sources, be as specific as possible in your SWPPP about the BMPs you will use to address them. The table at the left lists the sources of pollutants at construction sites, including sediment, the primary pollutant and other pollutants that may be present at construction sites.



Figure 5. Make sure storm drain inlets are protected.

¹ The runoff coefficient is the partial amount of the total rainfall which will become runoff. Runoff coefficients generally range from 0.95 (highly impervious) to 0.05 (vegetated surface that generates little runoff). For more information on calculating the runoff coefficient for your site, see Appendix C.

Non-Stormwater Discharges

Most permits will require you to identify any non-stormwater discharges in your SWPPP. Certain non-stormwater discharges may be allowed under the terms and conditions of your permit, however, you should make every effort to eliminate these discharges where possible. You should identify these sources in your SWPPP and identify pollution prevention measures to ensure that pollutants are not introduced to these discharges and carried to nearby waterbodies.

EPA's CGP identifies these allowable non-stormwater discharges: discharges from fire-fighting activities, fire hydrant flushings, waters used to wash vehicles, buildings, and pavements where detergents are not used, water used to control dust, potable water (including uncontaminated water line flushings), uncontaminated air conditioning condensate, uncontaminated ground water or spring water, among others. The permit goes on to say that non-stormwater discharges should be eliminated or reduced to the extent feasible and that the SWPPP should identify and ensure the implementation of appropriate pollution prevention measures for these discharges. More discussion of pollution prevention measures for some of these non-stormwater sources can be found in Chapter 5.

Permanent Stormwater Controls (Post-Construction)

The topic of designing, installing, and maintaining permanent or post-construction stormwater controls, although a requirement, is beyond the scope of this SWPPP guide. A SWPPP compiled in support of coverage under

EPA's Construction General Permit, however, needs to include a description of all permanent stormwater controls that will be constructed along with the buildings, roads, parking lots, and other structures. You should incorporate sediment and erosion controls into your SWPPP for areas where permanent stormwater controls, such as wet ponds, swales, and bioretention cells are to be constructed.

Effectively managing stormwater over the long-term—long after the actual construction process is over—is a significant challenge. Many communities (and a few states) have or are developing comprehensive requirements to better manage permanent (or post-construction) stormwater runoff. To be most effective, you should consider integrating your design process for your permanent stormwater controls into your overall design for your site. Planning for your permanent stormwater controls could affect your decisions about site design, location of buildings and other structures, grading, and preserving natural features. By preserving natural drainage patterns, trees, native vegetation, riparian buffers, and wetlands, you might need to construct fewer or smaller structural stormwater controls to cope with runoff from your site. Permanent stormwater controls should be designed with two important goals in mind: (1) reduction of the volume and velocity of runoff, and (2) reduction of the pollutants in the stormwater that does leave your site.

Techniques, such as *Low Impact Development*, *Better Site Design*, or *Conservation Development*, which emphasize addressing stormwater where it falls, infiltrating it, preserving natural drainage patterns, and

Take a Closer Look...

Specimen Trees and Natural Vegetation

Before a site plan is prepared, identify and clearly mark existing trees and vegetation you want to preserve. Some communities have tree preservation ordinances, and local extension service offices and foresters will often provide free advice on tree and plant preservation. Remember to notify all employees and subcontractors about trees and areas you intend to preserve and mark them clearly.

What does this mean to me?

Large trees and other native vegetation can represent significant value in the long term to property owners and the community at large. Many studies document that the presence of trees on residential and commercial sites provide many benefits including improved aesthetics, habitat for birds and other wildlife, and energy savings (shade) that ultimately enhance the economic value of the site. Trees also provide shade and act as windbreaks, which can reduce energy costs over the long term. By protecting existing trees, you can reduce landscaping costs and improve the appearance of a newly developed property. According to the National Arbor Day Foundation, trees around a home can increase its value by 15 percent or more.

preserving natural vegetation offer the best opportunity to protect nearby rivers, lakes, wetlands, and coastal waters. **Incorporating these ideas and concepts into the design for your project before it is built also offers the opportunity to reduce capital infrastructure and long-term maintenance costs.**

At the neighborhood or even at the watershed scale, *Smart Growth* techniques can help us design neighborhoods that minimize impacts on water quality, reduce air pollution, and improve the general quality of life for residents. **In the *Resources* list in Appendix D, you will find a list of suggestions on this topic, including how to incorporate Smart Growth and Low Impact Development techniques into the design of your site.**

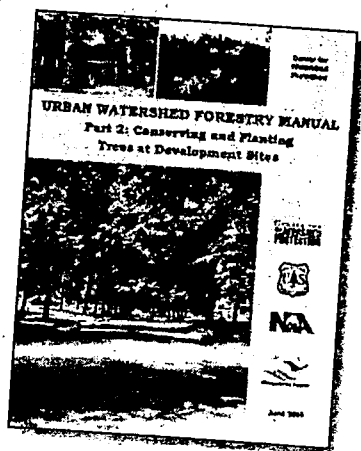
B. Identify Approaches to Protect Natural Resources

Preservation of natural areas, waterbodies, and open space has numerous economic, aesthetic, community, and environmental benefits. Preservation efforts also often increase the value of lots and homes and help to reduce overall expenditures on infrastructure. Specifically, these kinds of conservation efforts can help to significantly reduce the volume and velocity of stormwater runoff and the pollutants that may be carried with it.

SWPPP Tip!

Tree Preservation Resources

For more on tree preservation, contact your local extension service office or forester. Also, American Forests has useful information and tools at their website, www.americanforests.org/resources/urbanforests. The Center for Watershed Protection in cooperation with the U.S. Forest Service has developed a series of manuals on urban forestry. Part two, titled *Conserving and Planting Trees at Development Sites* will be of particular interest. You can find these manuals at www.cwp.org



Protect Nearby Waters

Your SWPPP should describe how you will protect and preserve any streams, wetlands, ponds or other waterbodies that are on your property or immediately adjoining it. Riparian areas around headwater streams are especially important to the overall health of the entire river system. Many states and communities have buffer or shoreline protection requirements to preserve sensitive areas around waterbodies.

Many states apply special designations to high-value or high-quality waters. Check with your state water pollution control agency to determine if your project could discharge to *outstanding* or special protection waters (such as wetlands, or salmon and trout streams). You might be subject to additional requirements to protect these waterbodies.

Wetland areas, including bogs, marshes, swamps, and prairie potholes may be found in areas adjacent to rivers, lakes, and coastal waters but may also be found in isolated places far from other surface waters. Many types of wetlands are protected under the Clean Water Act and construction activities in and around these areas may require an additional permit from the Army Corps of Engineers. Construction site operators should make every effort to preserve wetlands and must follow applicable local, state, and federal requirements before disturbing them or the areas around them.

To ensure the protection of natural areas during the construction period, you should use a combination of techniques, including temporary fencing, signage, and educating staff and subcontractors.

Assess Whether Your Project Impacts an Impaired Waterbody

Under the Clean Water Act, states are required to determine if rivers, lakes, and other waters are meeting water quality standards. When a waterbody does not meet water quality standards because of one or more sources of pollution, the state lists the water as impaired. When a water is determined to be impaired, the state or EPA develops a plan for correcting the situation. This plan is called a Total Maximum Daily Load (TMDL). If stormwater from your project could reach an impaired water with or without an approved TMDL (either directly or indirectly through a municipal storm drain system), your permit

may include additional requirements to ensure that your stormwater discharges do not contribute to that impairment and your stormwater controls are consistent with plans to restore that waterbody. Your SWPPP should describe the specific actions you will take to comply with these permit requirements for impaired waters.

You should determine, before you file for permit coverage, if the receiving waters for your project are impaired and if so, whether a TMDL has been developed for this waterbody. Visit EPA's Enviromapper website (www.epa.gov/waters/enviromapper) or contact your state environmental agency for more information.

Assess Whether You Have Endangered Plant or Animal Species in Your Area

The federal Endangered Species Act protects endangered and threatened species and their critical habitat areas. (States and tribes may have their own endangered species laws.) In developing the assessment of your site, you should determine whether listed endangered species are on or near your property. Critical habitat areas are often designated to support the continued existence of listed species. You should also determine whether critical habitat areas have been designated in the vicinity of your project. Contact your local offices of the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), or your state or tribal heritage centers. These organizations often maintain lists of federal and state listed endangered and threatened species on their Internet sites. For more information and to locate lists for your state, visit www.epa.gov/npdes/endangeredspecies

Additionally, your state's NPDES stormwater permit may specifically require that you address whether the activities and the stormwater discharged by your construction site have the potential to adversely affect threatened or endangered species or the critical habitat areas. You might need to conduct a biological investigation or assessment and document the results of the assessment in your SWPPP. The state may reference federal, state, or tribal endangered species protection laws or regulations.

EPA's Construction General Permit contains detailed procedures to assist construction site operators in determining the likely impact of

their projects on any endangered species or critical habitat. Construction site operators in areas covered by EPA's Construction General Permit are required to assess the impact of their activities and associated stormwater discharges on species and habitat in the "project area" which may extend beyond the site's immediate footprint.

Assess Whether You Have Historic Sites that Require Protection

The National Historic Preservation Act, and any state, local and tribal historic preservation laws, apply to construction activities. As with endangered species, some permits may specifically require you to assess the potential impact of your stormwater discharges on historic properties. However, whether or not this is stated as a condition for permit coverage, the National Historic Preservation Act and any applicable state or tribal laws apply to you. Contact your State Historic Preservation Officer (www.ncshpo.org/stateinfolist/fulllist.htm) or your Tribal Historic Preservation Officer (grants.cr.nps.gov/thpo/tribaloffices.cfm).

C. Develop Site Maps

The final step in the site evaluation process is to document the results of your site assessment and your planned phases of construction activity on a detailed site map or maps. This includes developing site maps showing planned construction activities and stormwater practices for the various major stages of construction, protected areas, natural features, slopes, erodible soils, nearby waterbodies, permanent stormwater controls, and so on. You must keep your SWPPP and your site maps up-to-date to reflect changes at your site during the construction process.

Location Maps

A general location map is helpful to identify nearby, but not adjacent, waterbodies in proximity to other properties. You can use any easily available maps or mapping software to create a location map.

Site Maps

The detailed construction site maps should show the entire site and identify a number of features at the site related to construction activities and stormwater management practices.

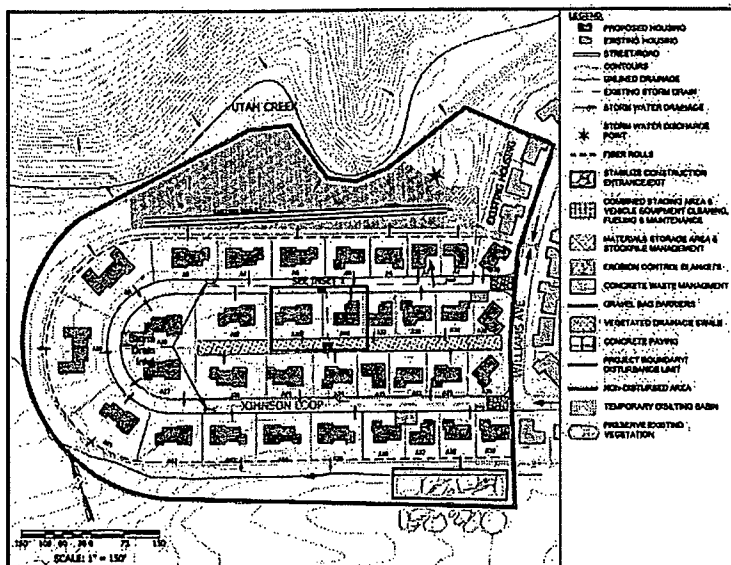


Figure 6. Example site map.

Map of undeveloped or existing site. For many sites, a map of the undeveloped or existing site, noting the features that you identified in Section A of this Chapter, will help you develop your SWPPP and identify current site features that you want to preserve. On this map note current drainage patterns, storm drains, slopes, soil types, waters and other natural features. Also note any existing structures, roads, utilities, and other features.

Map or series of maps for construction plans. Site maps should show the construction activities and stormwater management practices for each major phase of construction (e.g., initial grading, infrastructure, construction, and stabilization). The site maps should legibly identify the following features:

- Stormwater flow and discharges. Indicate flow direction(s) and approximate slopes after grading activities, as well as locations of discharges to surface waters or municipal storm drain systems.
- Areas and features to be protected. Include wetlands, nearby streams, rivers, lakes, and coastal waters, mature trees and natural vegetation, steep slopes, highly erodible soils, etc.
- Disturbed areas. Indicate locations and timing of soil disturbing activities (e.g. grading). Mark clearing limits.
- BMPs. Identify locations of structural and non-structural BMPs identified in

the SWPPP, as well as post-construction stormwater BMPs.

- Areas of stabilization. Identify locations where stabilization practices are expected to occur. Mark areas where final stabilization has been accomplished.
- Other areas and roads. Indicate locations of material, waste, borrow, or equipment storage.

You should complete your site maps after reviewing Chapters 4 and 5 and any applicable BMP design manual to select appropriate BMPs for your site.

Use Site Maps to Track Progress

Develop and keep up-to-date site maps showing non-structural BMPs that change frequently in location as the work on a construction site progresses. Your permit requires that you keep your SWPPP up-to-date, so mark up the site map with the location of these BMPs. Indicate the current location of the following:

- Portable toilets
- Material storage areas
- Vehicle and equipment fueling and maintenance areas
- Concrete washouts
- Paint and stucco washouts
- Dumpsters or other trash and debris containers
- Spill kits
- Stockpiles
- Any other non-structural non-stormwater management BMPs
- Any temporarily removed structural BMPs
- Any changes to the structural BMPs

If a marked-up site map is too full to be easily read, you should date and fold it, put it in the SWPPP for documentation, and start a new one. That way, there is a good hard copy record of what has occurred on-site.

Construction sites are dynamic. As conditions change at the construction site, such as the locations of BMPs, your SWPPP must reflect those changes.

Chapter 4: SWPPP Development—Selecting Erosion and Sediment Control BMPs

► This chapter presents a brief discussion of erosion and sediment control principles and a discussion of some commonly used BMPs.

This document is not intended as an engineering or design manual on BMPs. The engineer or other qualified person that develops the details of your sediment and erosion control plan should be using the appropriate state or local specifications. The descriptions below provide a kind of checklist of the things to look for and some helpful installation and maintenance hints.

Erosion and sediment controls are the structural and non-structural practices used during the construction process to keep sediment in place (erosion control) and to capture any sediment that is moved by stormwater before it leaves the site (sediment control). Erosion controls—keeping soil where it is—are the heart of any effective SWPPP. Your SWPPP should rely on erosion controls as the primary means of preventing stormwater pollution. Sediment controls provide a necessary second line of defense to properly designed and installed erosion controls.

The suite of BMPs that you include in your SWPPP should reflect the specific conditions at the site. The information that you collected in the previous steps should help you select the appropriate BMPs for your site. An effective SWPPP includes a combination or suite of BMPs that are designed to work together.

Ten Keys to Effective Erosion and Sediment Control (ESC)

The ultimate goal of any SWPPP is to protect rivers, lakes, wetlands, and coastal waters that could be affected by your construction project. The following principles and tips should help you build an effective SWPPP. **Keep in mind that there are many BMP options available to you. We have selected a few common BMPs to help illustrate the principles discussed in this chapter.**

Erosion Control (keeping the dirt in place) and Minimizing the Impact of Construction

1. Minimize disturbed area and protect natural features and soil
2. Phase construction activity
3. Control stormwater flowing onto and through the project
4. Stabilize soils promptly
5. Protect slopes

Sediment Controls (the second line of defense)

6. Protect storm drain inlets
7. Establish perimeter controls
8. Retain sediment on-site and control dewatering practices
9. Establish stabilized construction exits
10. Inspect and maintain controls

Take a Closer Look...

BMPs in Combination

BMPs work much better when they are used in combination. For instance, a silt fence should not be used alone to address a bare slope. An erosion control BMP should be used to stabilize the slope, and the silt fence should serve as the backup BMP.

What does this mean to me?

Wherever possible, rely on erosion controls to keep sediment in place. Back up those erosion controls with sediment controls to ensure that sediment doesn't leave your site. Continually evaluate your BMPs. Are they performing well? Could the addition of a supplemental BMP improve performance? Should you replace a BMP with another one that might work better? Using BMPs in series also gives you some protection in case one BMP should fail.

Erosion Control and Minimizing the Impact of Construction

ESC Principle 1: Minimize disturbed area and protect natural features and soil. As you put together your SWPPP, carefully consider the natural features of the site that you assessed in Chapter 3. By carefully delineating and controlling the area that will be disturbed by grading or construction activities, you can greatly reduce the potential for soil erosion and stormwater pollution problems. Limit disturbed areas to only those necessary for the construction of your project. Natural vegetation is your best and cheapest erosion control BMP.

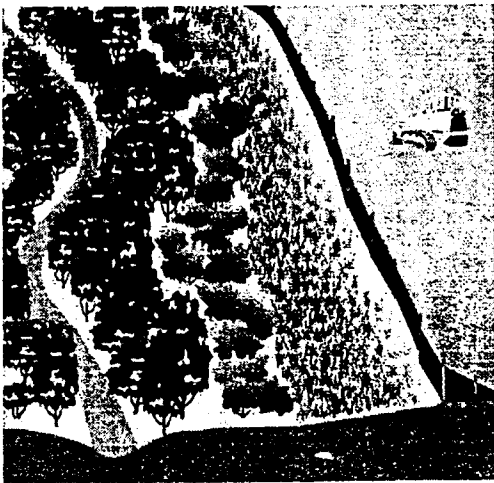


Figure 7. Protect vegetated buffers by using silt fence or other sediment controls.

Protecting and preserving topsoil is also a good BMP. Removing topsoil exposes underlying layers that are often more prone to erosion and have less infiltration capacity. Keeping topsoil in place preserves the natural structure of the soils and aids the infiltration of stormwater.

ESC Principle 2: Phase construction activity. Another technique for minimizing the duration of exposed soil is phasing. By scheduling or sequencing your construction work and concentrating it in certain areas, you can minimize the amount of soil that is exposed to the elements at any given time. Limiting the area of disturbance to places where construction activities are underway and stabilizing them as quickly as possible can be one of your most effective BMPs.

ESC Principle 3: Control stormwater flowing onto and through your project. Plan for any potential stormwater flows coming onto the project area from upstream locations, and divert (and slow) flows to prevent erosion. Likewise, the volume and velocity of on-site stormwater runoff should be controlled to minimize soil erosion.

Example BMP: Diversion Ditches or Berms

Description: Diversion ditches or berms direct runoff away from unprotected slopes and may also direct sediment-laden runoff to a sediment-trapping structure. A diversion ditch can be located at the upslope side of a construction site to prevent surface runoff from entering the disturbed area. Ditches or berms on slopes need to be designed for erosive velocities. Also, ensure that the diverted water is released through a stable outlet and does not cause downslope or downstream erosion or flooding.

Installation Tips:

- Divert run-on and runoff away from disturbed areas
- Ensure that the diversion is protected from erosion, using vegetation, geotextiles, or other appropriate BMPs
- Divert sediment-laden water to a sediment-trapping structure
- Use practices that encourage infiltration of stormwater runoff wherever possible

Maintenance:

- Inspect diversions and berms, including any outlets, regularly and after each rainfall
- Remove any accumulated sediment

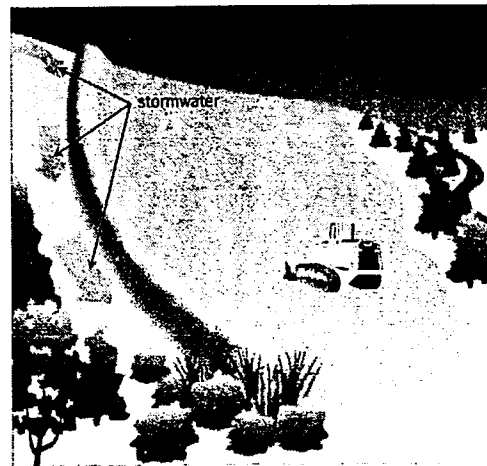


Figure 8. Illustration of a construction berm to divert stormwater away from the disturbed construction area.

ESC Principle 4: Stabilize soils promptly.

Where construction activities have temporarily or permanently ceased, you should stabilize exposed soils to minimize erosion. You should have stabilization measures in place after grading activities have ceased (many permits require stabilization within a specified time frame). You can provide either temporary or permanent cover to protect exposed soils. Temporary measures are necessary when an area of a site is disturbed but where activities in that area are not completed or until permanent BMPs are established. Topsoil stockpiles should also be protected to minimize any erosion from these areas. Temporary-cover BMPs include temporary seeding, mulches, matrices, blankets and mats, and the use of soil binders (there may be additional state and local requirements for the use of chemical-based soil binders). Permanent-cover BMPs include permanent seeding and planting, sodding, channel stabilization, and vegetative buffer strips. Silt fence and other sediment control measures are not stabilization measures.

SWPPP Tip!

Final Stabilization

Once construction activity in an area is completed and the area is stabilized (typically by achieving 70 percent permanent vegetative cover), you can mark this area on your SWPPP and discontinue inspections in that area. By bringing areas of your site to final stabilization, you can reduce your workload associated with maintaining and inspecting BMPs. For more information on final stabilization, see Chapter 9.

Example BMP: Temporary Seeding

Description: Temporarily seeding an area to establish vegetative cover is one of the most effective, and least expensive, methods of reducing erosion. This approach, as a single BMP, might not be appropriate on steep slopes, when vegetation cannot be established quickly enough to control erosion during a storm event, or when additional activities might occur soon in the area.

Installation Tips:

- Seed and mulch area (the mulch provides temporary erosion protection by protecting the soil surface, moderating temperature, and retaining moisture while seeds germinate and grow)

- Water regularly, if needed, to ensure quick growth
- Maintain backup BMPs, such as silt fence or settling ponds

SWPPP Tip!

Wind Control BMPs

In areas where dust control is an issue, your SWPPP should include BMPs for wind-erosion control. These consist of mulching, wet suppression (watering), and other practices.

ESC Principle 5: Protect slopes. Protect all slopes with appropriate erosion controls. Steeper slopes, slopes with highly erodible soils, or long slopes require a more complex combination of controls. Erosion control blankets, bonded fiber matrices, or turf reinforcement mats are very effective options. Silt fence or fiber rolls may also be used to help control erosion on moderate slopes and should be installed on level contours spaced at 10- to 20-foot intervals. You can also use diversion channels and berms to keep stormwater off slopes.

Example BMP: Rolled erosion control products

Description: Erosion control products include mats, geotextiles, and erosion control blankets and products that provide temporary stabilization and help to establish vegetation on disturbed soils. Such products help control erosion and help establish vegetation and are often used on slopes, channels, or stream banks.

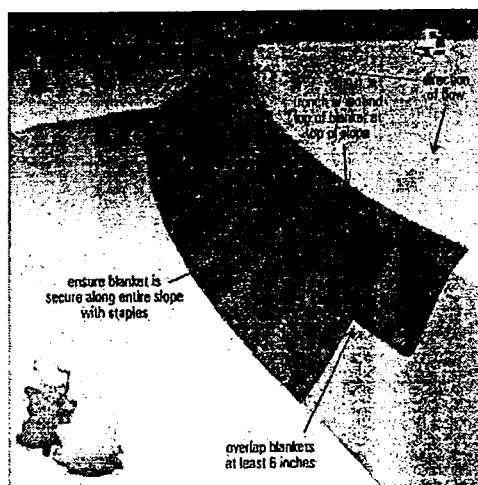


Figure 9. Illustration of erosion control blankets installed on slope.

Installation Tips:

- Use rolled erosion-control products on slopes steeper than 3 to 1 (horizontal to vertical) and in swales or long channels

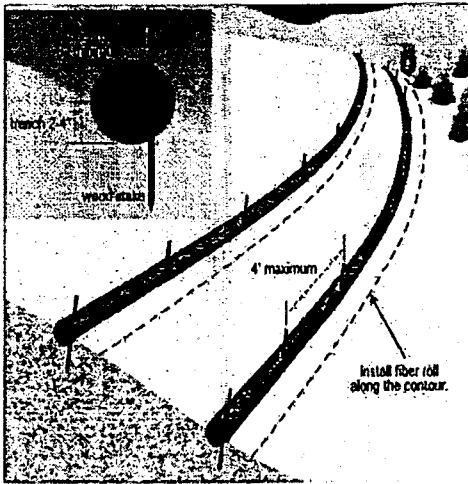


Figure 10. Illustration of a fiber roll installation along a slope.

- Trench the top of the blanket into the ground to prevent runoff from flowing under the blanket
- Overlap the lower end of the top mat over the top of the downslope mat to ensure that runoff stays on top of the blankets and mats
- Staple blankets and mats according to specifications

Maintenance:

- Periodically inspect for signs of erosion or failure
- Repair the blanket or mat if necessary
- Continue inspections until vegetation is established at the level required to qualify as final *stabilization*

ESC Principle 6: Protect storm drain

inlets. Protect all inlets that could receive stormwater from the project until final stabilization of the site has been achieved. Install inlet protection before soil-disturbing activities begin. Maintenance throughout the construction process is important. Upon completion of the project, storm drain inlet protection is one of the temporary BMPs that should be removed. Storm drain inlet protection should be used not only for storm drains within the active construction project, but also for storm drains outside the project area that might receive stormwater discharges from the project. If there are storm drains on private property that could receive stormwater runoff from your project, coordinate with the owners of that property to ensure proper inlet protection.

Example BMP: Storm Drain Inlet Protection

Description: Storm drain inlet protection prevents sediment from entering a storm drain by surrounding or covering the inlet with a filtering material. Several types of filters are commonly used for inlet protection: silt fence, rock-filled bags, or block and gravel. The type of filter used depends on the inlet type (for example, curb inlet, drop inlet), slope, and volume of flow. Many different commercial inlet filters are also available. Some commercial inlet filters are placed in front of or on top of an inlet, while others are placed inside the inlet under the grate.

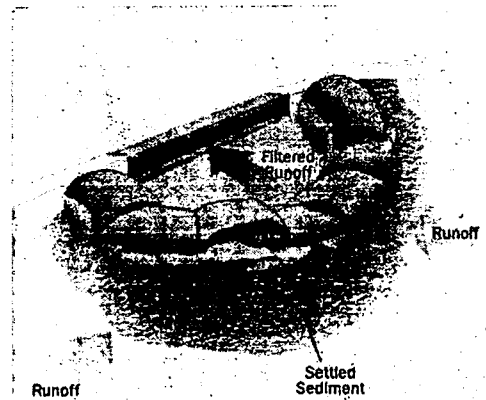


Figure 11. Illustration of a storm drain inlet with rock-filled bags filtering stormwater.

Installation Tips:

- Install inlet protection as soon as storm drain inlets are installed and before land-disturbance activities begin in areas with existing storm drain systems
- Protect all inlets that could receive stormwater from your construction project
- Use in conjunction with other erosion prevention and sediment control BMPs—remember, inlet protection is a secondary BMP!
- Design your inlet protection to handle the volume of water from the area being drained. Ensure that the design is sized appropriately.

Maintenance:

- Inspect inlets frequently and after each rainfall

- Remove accumulated sediment from around the device and check and remove any sediment that might have entered the inlet
- Replace or repair the inlet protection if it becomes damaged
- Sweep streets, sidewalks, and other paved areas regularly

SWPPP Tip!

Storm drain inlet protection should never be used as a primary BMP! Use erosion control techniques such as hydromulching or erosion-control blankets to prevent erosion. Use inlet protection and other sediment control BMPs as a *backup* or last line of defense.

ESC Principle 7: Establish perimeter controls. Maintain natural areas and supplement them with silt fence and fiber rolls around the perimeter of your site to help prevent soil erosion and stop sediment from leaving the site. Install controls on the downslope perimeter of your project (it is often unnecessary to surround the entire site with silt fence). Sediment barriers can be used to protect stream buffers, riparian

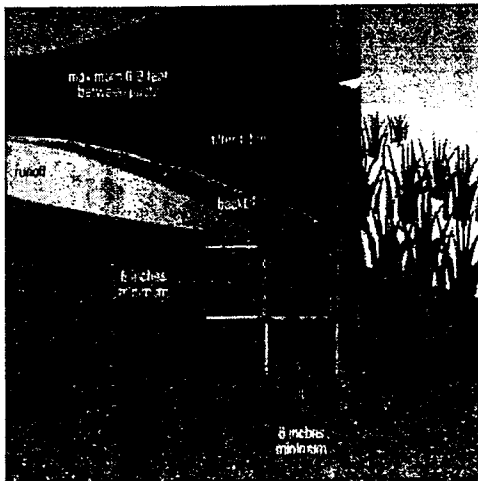


Figure 12. Illustration of proper techniques to use in installing silt fence.

areas, wetlands, or other waterways. They are effective only in small areas and should not be used in areas of concentrated flow.

Example BMP: Silt Fence and Fiber Rolls

Description: A silt fence is a temporary sediment barrier consisting of a geotextile attached to supporting posts and trenched into the ground. Silt fencing is intended to retain sediment that has been dislodged by stormwater. It is designed only for runoff from small areas and is not intended to handle flows from large slopes or in areas of concentrated flow. Fiber rolls serve the same purpose and consist of an open mesh tubular sleeve filled with a fibrous material which traps sediment. Fiber rolls are generally staked to the ground.

Installation Tips:

DO:

- Use silt fence or fiber rolls as perimeter controls, particularly at the lower or down slope edge of a disturbed area
- Leave space for maintenance between toe of slope and silt fence or roll
- Trench in the silt fence on the uphill side (6 inches deep by 6 inches wide)
- Install stakes on the downhill side of the fence or roll
- Curve the end of the silt fence or fiber roll up-gradient to help it contain runoff

DON'T:

- Install a silt fence or fiber rolls in ditches, channels, or areas of concentrated flow
- Install it running up and down a slope or hill
- Use silt fencing or fiber rolls alone in areas that drain more than a quarter-acre per 100 feet of fence

Maintenance:

- Remove sediment when it reaches one-third of the height of the fence or one-half the height of the fiber roll
- Replace the silt fence or roll where it is worn, torn, or otherwise damaged
- Retrench or replace any silt fence or roll that is not properly anchored to the ground

ESC Principle 8: Retain sediment on-site and control dewatering practices. Sediment barriers described in ESC Principle 7 can trap sediment from small areas, but when sediment retention from a larger area is required, consider using a temporary sediment trap or sediment basin. These practices detain sediment-laden runoff for a period of time, allowing sediment to settle before the runoff is discharged. Proper design and maintenance are essential to ensure that these practices are effective.

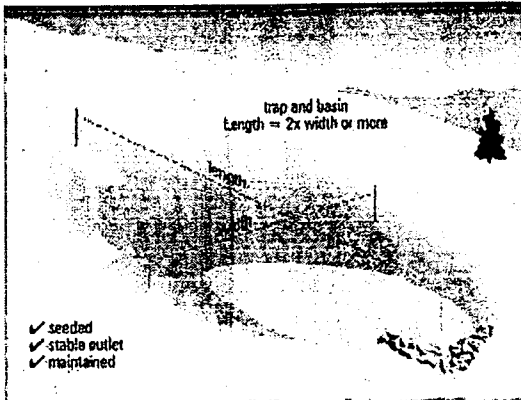


Figure 13. Illustration of a sediment basin.

You should use a sediment basin for common drainage locations that serve an area with 10 or more acres disturbed at any one time. The basin should be designed to provide storage for

the volume of runoff from the drainage area for at least a 2-year, 24-hour storm (or 3,600 cubic feet of storage per acre drained, which is enough to contain 1 inch of runoff, if the 2-year, 24-hour calculation has not been performed). Check your permit for exact basin sizing requirements. Sediment basins should be located at low-lying areas of the site and on the down-gradient side of bare soil areas where flows converge. Do not put sediment traps or basins in or immediately adjacent to flowing streams or other waterways.

Where a large sediment basin is not practical, use smaller sediment basins or sediment traps (or both) where feasible. At a minimum, use silt fences, vegetative buffer strips, or equivalent sediment controls for all down-gradient boundaries (and for those side-slope boundaries deemed appropriate for individual site conditions).

Dewatering practices are used to remove ground water or accumulated rain water from excavated areas. Pump muddy water from these areas to a temporary or permanent sedimentation basin or to an area completely enclosed by silt fence in a flat vegetated area where discharges can infiltrate into the ground.

Never discharge muddy water into storm drains, streams, lakes, or wetlands unless the sediment has been removed before discharge.

Keep in mind that some states and local jurisdictions require a separate permit for dewatering activities at a site.

ESC Principle 9: Establish stabilized construction exits. Vehicles entering and leaving the site have the potential to track significant amounts of sediment onto streets. Identify and clearly mark one or two locations where vehicles will enter and exit the site and focus stabilizing measures at those locations. Construction entrances are commonly made from large crushed rock. They can be further stabilized using stone pads or concrete. Also, steel wash racks and a hose-down system will remove even more mud and debris from vehicle tires. Divert runoff from wash areas to a sediment trap or basin. No system is perfect, so sweeping the street regularly completes this BMP.

Example BMP: Stabilized Construction Exit

Description: A rock construction exit can reduce the amount of mud transported onto paved roads by vehicles. The construction exit does this by removing mud from vehicle tires before the vehicle enters a public road.

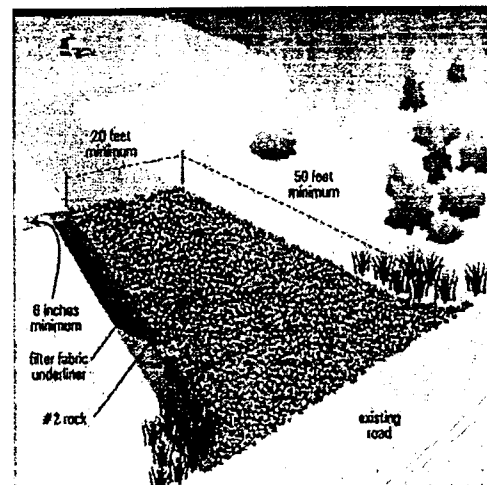


Figure 14. Illustration of a stabilized construction exit.

You might also want to install a wheel wash when mud is especially difficult to remove or space doesn't allow sufficient tire revolutions (four or five are needed) before exiting the site. Direct wash water to a suitable settling area—do not discharge wash water to a stream or storm drain!

Installation tips:

- Ensure that the exit is at least 50 feet long (generally, the length of two dump trucks) and graded so runoff does not enter the adjacent street
- Place a geotextile fabric under a layer of aggregate at least 6–12 inches thick. The stones or aggregate should be 3–6 inches in diameter
- Train employees and subcontractors to use the designated construction exits. Empower your employees to provide directions to subcontractors and others that are not on the site every day

Maintenance:

- Replenish or replace aggregate if it becomes clogged with sediment
- Sweep the street regularly

ESC Principle 10: Inspect and maintain controls. Inspection and maintenance is just as important as proper planning, design, and installation of controls. Without adequate maintenance, erosion and sediment controls will quickly fail, sometimes after just one rainfall, and cause significant water quality problems and potential violations of the NPDES construction general permit. Your permit likely requires you to maintain your BMPs at all times. To do this effectively, you should establish an inspection and maintenance approach or strategy that includes both regular and spot inspections. Inspecting both prior to predicted storm events and after will help ensure that controls are working effectively. Perform maintenance or corrective action as soon as problems are noted. **Inspection and maintenance of BMPs are addressed in more detail in Chapter 6.**

Other Sediment and Erosion Control Techniques

As mentioned at the beginning of this chapter, there are many other erosion and sediment control techniques that can be used effectively. The BMPs highlighted in this chapter are among those more commonly used and highlight many general erosion and sediment control principles for which other BMPs may be used effectively. Check to see if your state or local government has developed a BMP design manual for detailed information on any BMP you are considering. Appendix D lists several good BMP design manuals. You can also find out more about various BMPs by visiting EPA's Menu of BMPs at www.epa.gov/npdes/menuofbmps

The following BMPs are also commonly used at construction sites.

Erosion control measures:

- Surface roughening, trackwalking, scarifying, sheepsfoot rolling, imprinting
- Soil bioengineering techniques (e.g., live staking, fascines, brush wattles)
- Composting
- Sodding

Sediment control and runoff management measures:

- Gravel bag barrier
- Compost berm
- Rock or brush filters
- Baffles or skimmers in sediment basins to increase effectiveness
- Lowering soil levels near streets and sidewalks to prevent runoff
- Level spreaders
- Energy dissipaters
- Check dams

Chapter 5: SWPPP Development—Selecting Good Housekeeping BMPs

Six Key Pollution Prevention Principles for Good Housekeeping

Construction projects generate large amounts of building-related waste, which can end up polluting stormwater runoff if not properly managed. The suite of BMPs that are described in your SWPPP must include pollution prevention (P2) or good housekeeping practices that are designed to prevent contamination of stormwater from a wide range of materials and wastes at your site. The six principles described below are designed to help you identify the pollution prevention practices that should be described in your SWPPP and implemented at your site.

1. Provide for waste management
2. Establish proper building material staging areas
3. Designate paint and concrete washout areas
4. Establish proper equipment/vehicle fueling and maintenance practices
5. Control equipment/vehicle washing and allowable non-stormwater discharges
6. Develop a spill prevention and response plan

P2 Principle 1: Provide for waste management. Design proper management procedures and practices to prevent or reduce the discharge of pollutants to stormwater from solid or liquid wastes that will be generated at your site. Practices such as trash disposal, recycling, proper material handling, and cleanup measures can reduce the potential for stormwater runoff to pick up construction site wastes and discharge them to surface waters.

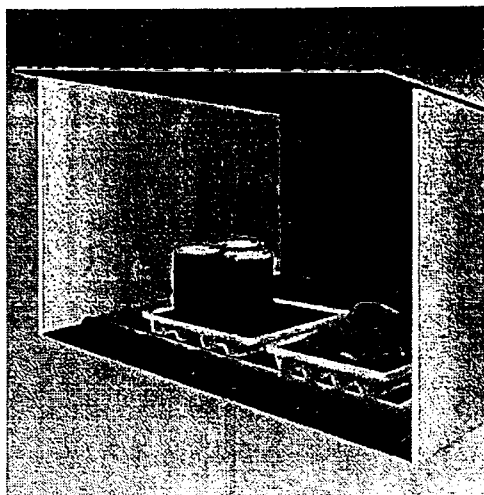


Figure 15. Illustration showing construction materials with secondary containment and overhead cover to prevent stormwater contamination.

Provide convenient, well-maintained, and properly located toilet facilities. Provide for regular inspections, service, and disposal. Locate toilet facilities away from storm drain inlets and waterways to prevent accidental spills and contamination of stormwater. Treat or dispose of sanitary and septic waste in accordance with state or local regulations.

Proper material use, storage, waste disposal, and training of employees and subcontractors can prevent or reduce the discharge of hazardous and toxic wastes to stormwater. Implement a comprehensive set of waste-management practices for hazardous or toxic materials, such as paints, solvents, petroleum products, pesticides, wood preservatives, acids, roofing tar, and other materials. Practices should include storage, handling, inventory, and cleanup procedures, in case of spills (see the following P2 principles).

► This chapter presents a brief discussion of good housekeeping principles to consider to ensure your construction site does not contaminate stormwater runoff.

As noted in Chapter 3, sediment is the principal pollutant of concern in stormwater discharges from construction sites. But, EPA's CGP and many state construction general permits require that the SWPPP describe good housekeeping measures for other pollutants that might be found on construction sites. This chapter discusses these measures.

Waste Management Checklist

Solid or Construction Waste

- ✓ Designate trash and bulk waste-collection areas on-site
- ✓ Recycle materials whenever possible (e.g., paper, wood, concrete, oil)
- ✓ Segregate and provide proper disposal options for hazardous material wastes
- ✓ Clean up litter and debris from the construction site daily
- ✓ Locate waste-collection areas away from streets, gutters, watercourses, and storm drains. Waste-collection areas (dumpsters, and such) are often best located near construction site entrances to minimize traffic on disturbed soils. Consider secondary containment around waste collection areas to further minimize the likelihood of contaminated discharges.

Sanitary and Septic Waste

- ✓ Provide restroom facilities on-site
- ✓ Maintain clean restroom facilities and empty porta-johns regularly
- ✓ Provide secondary containment pans under porta-johns, where possible
- ✓ Provide tie-downs or stake downs for porta-johns in areas of high winds
- ✓ Educate employees, subcontractors, and suppliers on locations of facilities
- ✓ Do not discharge or bury wastewater at the construction site
- ✓ Inspect facilities for leaks, repair or replace immediately

Hazardous Materials and Wastes

- ✓ Develop and implement employee and subcontractor education, as needed, on hazardous and toxic waste handling, storage, disposal, and cleanup
- ✓ Designate hazardous waste-collection areas on-site
- ✓ Place all hazardous and toxic material wastes in secondary containment
- ✓ Hazardous waste containers should be inspected to ensure that all containers are labeled properly and that no leaks are present

P2 Principle 2: Establish proper building material handling and staging areas.

Your SWPPP should include comprehensive handling and management procedures for building materials, especially those that are hazardous or toxic. Paints, solvents, pesticides, fuels and oils, other hazardous materials or any building materials that have the potential to contaminate stormwater should be stored indoors or under cover whenever possible or in areas with secondary containment. Secondary containment prevents a spill from spreading across the site and include dikes, berms, curbing, or other containment methods. Secondary containment techniques should also ensure the protection of ground water. Designate staging areas for activities such as fueling vehicles, mixing paints, plaster, mortar, and so on. Designated staging areas will help you to monitor the use of materials and to clean up any spills. Training employees and subcontractors is essential to the success of this pollution prevention principle.

SWPPP Tip!

Material Staging Area Measures

Your SWPPP should include procedures for storing materials that can contribute pollutants to stormwater. Consider the following:

- Train employees and subcontractors in proper handling and storage practices
- Designate site areas for storage. Provide storage in accordance with secondary containment regulations and provide cover for hazardous materials when necessary. Ensure that storage containers are regularly inspected for leaks, corrosion, support or foundation failure, or any other signs of deterioration and tested for soundness
- Reuse and recycle construction materials when possible

P2 Principle 3: Designate washout areas.

Concrete contractors should be encouraged, where possible, to use the washout facilities at their own plants or dispatch facilities. If it is necessary to provide for concrete washout areas on-site, designate specific washout areas and design facilities to handle anticipated washout water. Washout areas should also be provided for paint and stucco operations. Because washout areas can be a source of pollutants from leaks or spills,

EPA recommends that you locate them at least 50 yards away from storm drains and watercourses whenever possible.

Several companies rent or sell prefabricated washout containers, and some provide disposal of waste solids and liquids along with the containers. These prefabricated containers are sturdy and provide a more reliable option for preventing leaks and spills of wash water than self-constructed washouts. Alternatively, you can construct your own washout area, either by digging a pit and lining it with 10 mil plastic sheeting or creating an aboveground structure from straw bales or sandbags with a plastic liner. If you create your own structure, you should inspect it daily for leaks or tears in the plastic because these structures are prone to failure.

Regular inspection and maintenance are important for the success of this BMP. Both self-constructed and prefabricated washout containers can fill up quickly when concrete, paint, and stucco work are occurring on large portions of the site. You should also inspect for evidence that contractors are using the washout areas and not dumping materials onto the ground or into drainage facilities. If the washout areas are not being used regularly, consider posting additional signage, relocating the facilities to more convenient locations, or providing training to workers and contractors.

SWPPP Tip!

Washout Area Measures

When concrete, paint, or stucco is part of the construction process, consider these practices which will help prevent contamination of stormwater. Include the locations of these areas and your maintenance and inspection procedures in your SWPPP.

- Do not washout concrete trucks or equipment into storm drains, streets, gutters, uncontained areas, or streams.
- Establish washout areas and advertise their locations with signs.
- Provide adequate containment for the amount of wash water that will be used.
- Inspect washout structures daily to detect leaks or tears and to identify when materials need to be removed.
- Dispose of materials properly. The preferred method is to allow the water to evaporate and to recycle the hardened concrete. Full service companies may provide dewatering services and should dispose of wastewater properly. Concrete wash water can be highly polluted. It should not be discharged to any surface water, storm sewer system, or allowed to infiltrate into the ground. It should not be discharged to a sanitary sewer system without first receiving written permission from the system operator.

P2 Principle 4: Establish proper equipment/vehicle fueling and maintenance practices.

Performing equipment/vehicle fueling and maintenance at an off-site facility is preferred over performing these activities on the site, particularly for road vehicles (e.g., trucks, vans). For grading and excavating equipment, this is usually not possible or desirable. Create an on-site fueling and maintenance area that is clean and dry. The on-site fueling area should have a spill kit, and staff should know how to use it. If possible, conduct vehicle fueling and maintenance activities in a covered area; outdoor vehicle fueling and maintenance is a potentially significant source of stormwater pollution. Significant maintenance on vehicles and equipment should be conducted off-site.

SWPPP Tip!

Equipment/Vehicle Fueling and Maintenance Measures

Consider the following practices to help prevent the discharge of pollutants to stormwater from equipment/vehicle fueling and maintenance. Include the locations of these areas and your inspection and maintenance procedures in your SWPPP.

- Train employees and subcontractors in proper fueling procedures (stay with vehicles during fueling, proper use of pumps, emergency shut-off valves, and such).
- Inspect on-site vehicles and equipment daily for leaks, equipment damage, and other service problems.
- Clearly designate vehicle/equipment service areas away from drainage facilities and watercourses to prevent stormwater run-on and runoff.
- Use drip pans, drip cloths, or absorbent pads when replacing spent fluids.
- Collect all spent fluids, store in appropriate labeled containers in the proper storage areas, and recycle fluids whenever possible.

P2 Principle 5: Control equipment/vehicle washing and allowable non-stormwater discharges.

Environmentally friendly washing practices can be practiced at every construction site to prevent contamination of surface and ground water from wash water. Procedures and practices include using off-site facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water or routing to the sanitary sewer; and training employees and subcontractors in proper cleaning procedures.

Take a Closer Look...

Non-Stormwater Runoff

A construction site might have sources of runoff that are not generated by stormwater. These non-stormwater discharges include fire hydrant flushing, vehicle or equipment wash water (no detergents!), water used to control dust, and landscape irrigation.

What does this mean to me?

Take steps to infiltrate these sources of uncontaminated water into the ground. You can also route these sources of water to sediment ponds or detention basins or otherwise treat them with appropriate BMPs.

SWPPP Tip!

Equipment/Vehicle Washing Measures

The following equipment/vehicle washing measures will help prevent stormwater pollution. Include the location of your washing facilities and your inspection and maintenance procedures in your SWPPP.

- Educate employees and subcontractors on proper washing procedures
- Clearly mark the washing areas and inform workers that all washing must occur in this area
- Contain wash water and treat and infiltrate it whenever possible
- Use high-pressure water spray at vehicle washing facilities without any detergents because water can remove most dirt adequately
- Do not conduct any other activities, such as vehicle repairs, in the wash area

requirements and ensure that clear and concise spill cleanup procedures are provided and posted for areas in which spills may potentially occur. When developing a spill prevention plan, include, at a minimum, the following:

- Note the locations of chemical storage areas, storm drains, tributary drainage areas, surface waterbodies on or near the site, and measures to stop spills from leaving the site
- Specify how to notify appropriate authorities, such as police and fire departments, hospitals, or municipal sewage treatment facilities to request assistance
- Describe the procedures for immediate cleanup of spills and proper disposal
- Identify personnel responsible for implementing the plan in the event of a spill

P2 Principle 6: Develop a spill prevention and response plan. Most state and EPA construction general permits require the preparation of spill prevention and response plans. Generally, these plans can be included or incorporated into your SWPPP. The plan should clearly identify ways to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and response. The plan should also specify material handling procedures and storage

SWPPP Tip!

Spill Prevention Measures

Additional spill prevention measures that will help prevent spills and leaks include the following:

- Describe and list all types of equipment to be used to adequately clean up the spill
- Provide proper handling and safety procedures for each type of waste
- Establish an education program for employees and subcontractors on the potential hazards to humans and the environment from spills and leaks
- Update the spill prevention plan and clean up materials as changes occur to the types of chemicals stored and used at the facility

Take a Closer Look...

Spill Prevention, Control and Countermeasure (SPCC) Plan

Construction sites may be subject to 40 CFR Part 112 regulations that require the preparation and implementation of a SPCC Plan to prevent oil spills from aboveground and underground storage tanks. Your facility is subject to this rule if you are a nontransportation-related facility that:

- Has a total storage capacity greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons and
- Could reasonably be expected to discharge oil in quantities that may be harmful to navigable waters of the United States and adjoining shorelines

Furthermore, if your facility is subject to 40 CFR Part 112, your SWPPP should reference the SPCC Plan. To find out more about SPCC Plans, see EPA's website on SPCC at www.epa.gov/oilspill/spcc.htm

What does this mean to me?

Reporting Oil Spills

In the event of an oil spill, you should contact the National Response Center toll free at 1-800-424-8802 for assistance, or for more details, visit their website: www.nrc.uscg.mil/nrchp.html

Chapter 6: SWPPP Development—Inspections, Maintenance, and Recordkeeping

► This chapter describes the inspection and maintenance procedures your SWPPP should include, as well as recordkeeping requirements.

A. Describe Your Plans and Procedures for Inspecting BMPs

Earlier discussions in this manual pointed out that the effectiveness of erosion and sediment control BMPs and good housekeeping and pollution prevention measures depend on consistent and continual inspection and maintenance. This step focuses on developing a plan for BMP inspection and maintenance to ensure that a schedule and procedures are in place.

Inspections

Your responsibility does not stop after BMPs are installed. Your BMPs must be maintained in good working order at all times. Further, your permit requires that you conduct regular inspections and document the findings of those inspections in your SWPPP.

Your construction general permit describes the *minimum* frequency of inspections, which is typically weekly or bi-weekly and after each rainfall event exceeding one-half inch. To meet the requirement to maintain all BMPs in good working order, EPA recommends that you develop an inspection schedule that goes beyond these minimums and is customized for your site and the conditions affecting it.

In developing your inspection schedule consider the following:

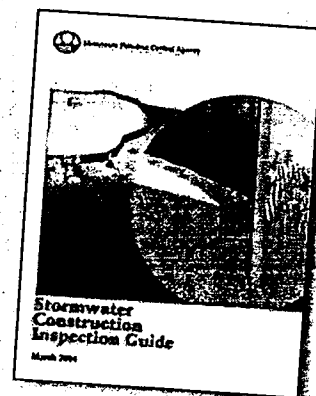
- Consider using *spot* inspections. You may want to inspect certain parts of your site more frequently or even daily. Target places that need extra attention, such as areas around construction site entrances, check nearby streets for dirt, check inlet protection, and so on.
- Consider using informal inspections. Your permit outlines the minimum requirements for formal inspections that must be documented and included in your SWPPP. You can also add informal inspections that wouldn't require documentation, unless of course, a problem is identified. Always document any problems you find and those that are identified by staff.
- Consider adding inspections *before or even during* rain events. Many permits require inspections of BMPs after rain events. You should consider adding inspections *before or during* predicted rain events. Consult a local weather source and initiate inspections before predicted storm events as a way to ensure that controls are operational.
- Train staff and subcontractors. Use your staff and subcontractors to help identify any potential problems with your BMPs. Again, document any issues that are confirmed problems.

EPA recommends that you develop an inspection schedule that meets the needs of your site. You'll probably also want to update and refine this schedule based on your experiences, the findings of your inspections, and the changing conditions at your site.

SWPPP Tip!

Inspection Guide

The State of Minnesota has developed a *Stormwater Construction Inspection Guide* to assist municipal site inspectors in procedures for conducting a compliance inspection at construction sites. This guide can also be useful for construction operators conducting self-inspections. Available at www.pca.state.mn.us/water/stormwater/stormwatr-c.html



SWPPP Tip!

Selecting BMP Inspectors

A BMP inspection is only as good as the inspector. Therefore, it is important to select qualified personnel to conduct BMP inspections. The SWPPP should identify who has the responsibility for conducting inspections. Personnel selected to conduct inspections should be knowledgeable in the principles and practices of erosion and sediment controls, possess the technical skills to assess conditions at the construction site that could impact stormwater quality, and assess the effectiveness of any sediment and erosion control measures selected.

Several states and other organizations offer training that will help prepare inspectors to accurately evaluate BMPs, decide when maintenance is appropriate, or when a different BMP should be substituted. (Several states require that sites be inspected by someone that the state certifies as a qualified inspector.) One national organization offers two certification programs that would be useful for personnel who are developing and implementing SWPPPs and conducting inspections. These certification programs are called: "Certified Professional in Erosion and Sediment Control (CPESC)" and "Certified Professional in Stormwater Quality (CPSWQ)." You can find more information on these programs at www.cpesc.org

Inspection Reports

Complete an inspection report after each inspection. You should retain copies of all inspection reports and keep them with or in your SWPPP. Generally, the following information is required to be included in your inspection report:

- Inspection date
- Inspector information, including the names, titles, and qualifications of personnel conducting the inspection
- Weather information for the period since the last inspection (or for the first inspection since commencement of construction activity) including a best estimate of the beginning of each storm, its duration, approximate amount of rainfall for each storm (in inches), and whether any discharges occurred. You may create a log to record the basic weather information or you may keep copies of weather information from a reliable local source, such as the internet sites of local newspapers, TV stations, local universities, etc.
- Current weather information and a description of any discharges occurring at the time of the inspection
- Descriptions of evidence of previous or ongoing discharges of sediment or other pollutants from the site
- Location(s) of BMPs that need to be maintained
- Location(s) of BMPs that failed to operate as designed or proved inadequate for a location
- Location(s) where additional BMPs are needed but did not exist at the time of inspection
- Corrective action required, including any necessary changes to the SWPPP and implementation dates
- Reference to past corrective actions documenting follow-up actions taken

Consider taking digital photographs during inspections to document BMPs, problems identified, and progress in implementing the SWPPP.

Appendix B includes an example stormwater inspection report. You should use this report, or a similar report, to document your stormwater construction site inspections. Check to see if your state or local authority has developed an inspection checklist for your use. The inspection report is broken up into two main sections—site-specific BMPs and overall site issues. For the site-specific BMPs, you should number the structural and non-structural BMPs in your SWPPP on a copy of your site map (preferably in the order in which you would inspect them on the site). Then as you conduct your inspections, you can verify whether each BMP has been installed and maintained. If a BMP has not been installed or needs maintenance, describe this in the corrective action section and list a date for when the corrective action will be completed and who will be responsible for completing the action. The overall site issues section describes 11 common issues at construction sites you should inspect for. You can customize this form to meet the needs of your particular situation.

Make sure each inspection report is signed and certified consistent with your permit's requirements.

Chapter 8, Section D contains more information on implementing an inspection program. Also, see the suggested inspection report form in Appendix B.

SWPPP Tip!

Consider More Effective BMPs

During inspections, consider whether the installed BMPs are working effectively. If you find a BMP that is failing or overwhelmed by sediment, you should consider whether it needs to be replaced with a more effective BMP or enhanced by the addition of another, complimentary BMP. Ensure that you record such changes in your SWPPP and on your site map.

B. BMP Maintenance

Implementing a good BMP maintenance program is essential to the success of your SWPPP and to your efforts to protect nearby waterways. You should conduct maintenance of BMPs regularly and whenever an inspection (formal or informal) identifies a problem or potential issue. For instance, trash and debris should be cleaned up, dumpsters should be checked and covered, nearby streets and sidewalks should be swept daily, and so on. Maintenance on erosion and sediment controls should be performed as soon as site conditions allow. Consider the following points when conducting maintenance:

- Follow the designers or manufacturer's recommended maintenance procedures for all BMPs
- Maintenance of BMPs will vary according to the specific area and site conditions
- Remove sediment from BMPs as appropriate and properly dispose of sediment into controlled areas to prevent soil from returning to the BMP during subsequent rain events
- Remove sediment from paved roadways and from around BMPs protecting storm drain inlets
- Ensure that construction support activities, including borrow areas, waste areas, contractor work areas, and material storage areas and dedicated concrete and asphalt batch plants are cleaned and maintained
- Replace damaged BMPs, such as silt fences, that no longer operate effectively

You should keep a record of all maintenance activities, including the date, BMP, location, and maintenance performed in your SWPPP.

C. Recordkeeping

You must keep copies of the SWPPP, inspection records, copies of all reports required by the permit, and records of all data used to complete the NOI to be covered by the permit for a period of at least 3 years from the date that permit coverage expires or is terminated.

Records should include:

- A copy of the SWPPP, with any modifications
- A copy of the NOI and Notice of Termination (NOT) and any stormwater-related correspondence with federal, state, and local regulatory authorities
- Inspection forms, including the date, place, and time of BMP inspections
- Names of inspector(s)
- The date, time, exact location, and a characterization of significant observations, including spills and leaks
- Records of any non-stormwater discharges
- BMP maintenance and corrective actions taken at the site (Corrective Action Log)
- Any documentation and correspondence related to endangered species and historic preservation requirements
- Weather conditions (e.g., temperature, precipitation)
- Date(s) when major land disturbing (e.g. clearing, grading, and excavating) activities occur in an area
- Date(s) when construction activities are either temporarily or permanently ceased in an area
- Date(s) when an area is either temporarily or permanently stabilized

Chapter 7: Certification and Notification

► This chapter describes how, after developing your SWPPP, you can obtain permit coverage for your stormwater discharges.

A. Certification

Signature and Certification

The construction site operator must sign the permit application form, which is often called a *Notice of Intent* or *NOI*. (In some instances, the construction general permit may not require the submission of an *NOI* or application. Construction activities may be covered automatically.)

All reports, including SWPPPs and inspection reports, generally must be signed by the construction site operator or a duly authorized representative of that person. The authorized representative is typically someone who has direct responsibility for implementing the SWPPP. If the operator chooses to designate an authorized representative, a signed letter or statement to that effect must be included in the SWPPP. Check your permit for exact requirements.

Your SWPPP must include the signature of the construction site operator or authorized representative and the certification statement provided in the general permit. An example of the certification language from EPA's Construction General Permit follows:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

This ensures that the SWPPP was developed and reviewed by a responsible party with the ability to implement the BMPs and other commitments described in the SWPPP.

Copy of Permit Requirements

Most general permits require you to keep a copy of the permit and your *NOI* with your SWPPP. This allows you to quickly check the permit if a question arises about a permit requirement.

Other State, Tribal, and Local Programs

Include in your SWPPP a description of any other federal, state, tribal, or local requirements for erosion and sediment control and stormwater management that apply to your site. Many local governments also impose erosion and sediment control requirements; your SWPPP should comply with both the general permit and any applicable local requirements.

SWPPP Tip!

Posting a sign at the construction entrance

EPA and many state general permits require that you post a sign or other notice conspicuously near the main entrance of the construction site. EPA's permit requires that the sign contain a copy of the *NOI*, the location of the SWPPP, and a contact person for viewing the SWPPP.

SWPPP Tip!

Making your SWPPP available

While EPA and most states do not require you to submit a copy of your SWPPP for review, your SWPPP must be available to these and other government agencies for inspection. Your permit may also require you to make your SWPPP available to the public, if requested. If you have the ability, you should consider posting your SWPPP on the Internet and publicizing the URL. Check your permit for exact requirements.

B. Notification

Now that you have developed your SWPPP and before you begin construction, you must begin the process of obtaining permit coverage from your authorized state or EPA. Authorized states and EPA use *general* permits to cover all construction sites. These broadly written general or *umbrella* permits apply to all construction activities in a given state.

Obtaining Coverage Under a General Permit
Important! Before obtaining permit coverage, you should read a copy of the appropriate construction general permit and develop your SWPPP.

To obtain coverage under a state or EPA construction general permit, you will typically need to fill out and submit an application form, often called a Notice of Intent or NOI. Submitting this form to the permitting authority indicates your *intent* to be authorized to discharge stormwater under the appropriate general permit for construction activities. Depending on the permit, you may be authorized to discharge immediately or at some later time. In some cases, you are not authorized to discharge until the state has notified you accordingly. EPA's Construction General Permit requires a 7-day waiting period after a complete NOI is received and posted on EPA's website (www.epa.gov/npdes/noisearch). The waiting period expires when the permit's status changes from *waiting* to *active*.

Take a Closer Look...

Information on the Application or Notice of Intent (NOI)

The NOI provides the permitting authority with pertinent information about your construction site, such as owner/operator information, site location, estimated project start and completion dates, approximate area to be disturbed, information about your SWPPP, receiving waters, and endangered species review certification.

An appropriate person who is authorized to represent your organization must sign and verify that the facts contained in the NOI are true and accurate. For businesses, a certifying official is typically a corporate officer, such as a president, vice president, or manager of operations. For municipalities, it's typically a principal executive officer or ranking elected official. Check your permit for exact signature requirements.

In general, the only information you need to submit to the permitting authority is the NOI. EPA and most authorized state agencies do not require you to submit your SWPPP for approval. However, many local governments review and approve at least the erosion and sediment control component of your SWPPP.

What does this mean to me?

There are significant penalties for failing to obtain authorization to discharge or for submitting inaccurate information. If you are the certifying official, make sure you are authorized to discharge before construction activities begin.

SWPPP Tip!

Deadline for submitting NOIs under EPA's Construction General Permit

For EPA's construction general permit, the fastest and easiest way to obtain permit coverage is to use EPA's electronic permit application system, called "eNOI" at www.epa.gov/npdes/stormwater/enoi. Using this approach, you may be authorized to discharge in as little as 7 days after submission of your electronic NOI. If you choose to submit your NOI by mail, EPA recommends that you send it at least one month before you need permit coverage.

Chapter 8: SWPPP Implementation

A. Train Your Staff and Subcontractors

Your site's construction workers and subcontractors might not be familiar with stormwater BMPs, and they might not understand their role in protecting local rivers, lakes and coastal waters. Training your staff and subcontractors in the basics of erosion control, good housekeeping, and pollution prevention is one of the most effective BMPs you can institute at your site.

Basic training should include

- Spill prevention and cleanup measures, including the prohibition of dumping any material into storm drains or waterways
- An understanding of the basic purpose of stormwater BMPs, including what common BMPs are on-site, what they should look like, and how to avoid damaging them
- Potential penalties associated with stormwater noncompliance

Staff directly responsible for implementing the SWPPP should receive comprehensive stormwater training, including

- The location and type of BMPs being implemented
- The installation requirements and water quality purpose for each BMP
- Maintenance procedures for each of the BMPs being implemented
- Spill prevention and cleanup measures
- Inspection and maintenance recordkeeping requirements

You can train staff and subcontractors in several ways: short training sessions (food and refreshments will help increase attendance), posters and displays explaining your site's various BMPs, written agreements with subcontractors to educate their staff members, signs pointing out BMPs and reminders to keep clear of them. Every construction site operator should try to train staff and subcontractors to avoid damaging BMPs. By doing so, operators can avoid the added expense of repairs.

► Your SWPPP is your guide to preventing stormwater pollution. However, it is just a plan. Implementing your SWPPP, maintaining your BMPs, and then constantly reevaluating and revising your BMPs and your SWPPP are the keys to protecting your local waterways.

SWPPP Tip!

Train your staff and subcontractors!

Here are a few key things you will want to cover with each person working on your site:

- Use only designated construction site entrances
- Keep equipment away from silt fences, fiber rolls, and other sediment barriers
- Know the locations of disposal areas, and know the proper practices for trash, concrete and paint washout, hazardous chemicals, and so on
- Keep soil, materials, and liquids away from paved areas and storm drain inlets. Never sweep or wash anything into a storm drain
- Know the location and understand the proper use of spill kits
- Know the locations of your site's designated protection areas. Keep equipment away from stream banks, valuable trees and shrubs, and steep slopes. Clearly mark these areas with signs
- Keep equipment off mulched, seeded, or stabilized areas. Post signs on these areas, too
- Know who to contact when problems are identified!

B. Ensure Responsibility—Subcontractor Agreements

At any given site, there might be multiple parties (developer, general contractor, builders, subcontractors) that have roles and responsibilities for carrying out or maintaining stormwater BMPs at a given site. These roles and responsibilities should be documented clearly in the SWPPP (see Chapter 2, Section D). In some cases (state requirements vary), there may be one entity that has developed the SWPPP and filed for permit coverage and, therefore, is designated as the *operator*. When other parties at a site are not officially designated as operators, many operators are incorporating the roles and responsibilities of these *non-operators* in the agreements and contracts they have with these companies and individuals. This contract language should spell out responsibilities implementing and maintaining stormwater BMPs, for training staff, and for correcting damage to stormwater BMPs on the site. Several states have stormwater regulations that hold other parties liable even if they are not identified as the *operator*.

C. Implement Your SWPPP Before Construction Starts

Once you have obtained permit coverage and you are ready to begin construction, it is time to implement your SWPPP. You must implement appropriate parts of your SWPPP before construction activity begins. This generally involves installing storm drain inlet protection, construction entrances, sediment basins, and perimeter silt fences before clearing, grading, and excavating activities begin.

After construction activities begin, your SWPPP should describe when additional erosion and sediment controls will be installed (generally after initial clearing and grading activities are complete). You should also begin BMP inspections once clearing and grading activities begin.

SWPPP Tip!

Take Photographs During Inspections

Taking photographs can help you document areas that need maintenance and can help identify areas where subcontractors might need to conduct maintenance. Photographs can also help provide documentation to EPA or state inspectors that maintenance is being performed.

SWPPP Tip!

Prepare for the rain and snowmelt!

In some areas of the country, construction site operators are required to develop *weather triggered* action plans that describe additional activities the operator will conduct 48 hours before a predicted storm (at least a 50 percent forecasted chance of rain). It is also a good idea to stockpile additional erosion and sediment control BMPs (such as silt fencing, and fiber rolls) at the site for use when necessary.

D. Conduct Inspections and Maintain BMPs

As mentioned earlier (Chapter 6), EPA recommends that you develop an inspection schedule for your site that considers the size, complexity, and other conditions at your site. This should include regularly scheduled inspections and less formal inspections. EPA recommends that you develop a plan that includes inspections before and after anticipated rain events. You might also want to inspect some BMPs during rain events to see if they are actually keeping sediment on site! Conducting inspections during rain events also allows a construction site operator to address minor problems before they turn into major problems.

Temporarily Removed BMPs

BMPs sometimes need to be temporarily removed to conduct work in an area of the site. These temporarily removed BMPs should be noted on the site plan and replaced as soon as possible after the completion of the activity requiring their removal. If a rain is forecast, the BMPs should be replaced as soon as possible before the rain event.

Recommended Inspection Sequence

You should conduct thorough inspections of your site, making sure to inspect all areas and BMPs. The seven activities listed below are a recommended inspection sequence that will help you conduct a thorough inspection (adapted from MPCA 2004).

1. Plan your inspection

- ☒ Create a checklist to use during the inspection (see Appendix B)
- ☒ Obtain a copy of the site map with BMP locations marked
- ☒ Plan to walk the entire site, including discharge points from the site and any off-site support activities such as concrete batch plants should also be inspected
- ☒ Follow a consistent pattern each time to ensure you inspect all areas (for example, starting at the lowest point and working uphill)

2. Inspect discharge points and downstream, off-site areas

- ☒ Inspect discharge locations to determine whether erosion and sediment control measures are effective
- ☒ Inspect nearby downstream locations, if feasible
- ☒ Walk *down the street* to inspect off-site areas for signs of discharge. This is important in areas with existing curbs and gutters
- ☒ Inspect downslope municipal catch basin inlets to ensure that they are adequately protected

3. Inspect perimeter controls and slopes

- ☒ Inspect perimeter controls such as silt fences to determine if sediment should be removed
- ☒ Check the structural integrity of the BMP to determine if portions of the BMP need to be replaced
- ☒ Inspect slopes and temporary stockpiles to determine if erosion controls are effective

4. Compare BMPs in the site plan with the construction site conditions

- ☒ Determine whether BMPs are in place as required by the site plan

- ☒ Evaluate whether BMPs have been adequately installed and maintained
- ☒ Look for areas where BMPs are needed but are missing and are not in the SWPPP

5. Inspect construction site entrances

- ☒ Inspect the construction exits to determine if there is tracking of sediment from the site onto the street
- ☒ Refresh or replace the rock in designated entrances
- ☒ Look for evidence of additional construction exits being used that are not in the SWPPP or are not stabilized
- ☒ Sweep the street if there is evidence of sediment accumulation

6. Inspect sediment controls

- ☒ Inspect any sediment basins for sediment accumulation
- ☒ Remove sediment when it reduces the capacity of the basin by the specified amount (many permits have specific requirements for sediment basin maintenance. Check the appropriate permit for requirements and include those in your SWPPP)

7. Inspect pollution prevention and good housekeeping practices

- ☒ Inspect trash areas to ensure that waste is properly contained
- ☒ Inspect material storage and staging areas to verify that potential pollutant sources are not exposed to stormwater runoff
- ☒ Verify that concrete, paint, and stucco washouts are being used properly and are correctly sized for the volume of wash water
- ☒ Inspect vehicle/equipment fueling and maintenance areas for signs of stormwater pollutant exposure

Common Compliance Problems During Inspections

The following are problems commonly found at construction sites. As you conduct your inspections, look for these problems on your site (adapted from MPCA 2004).

Problem #1—Not using phased grading or providing temporary or permanent cover (i.e., soil stabilization)

In general, construction sites should phase their grading activities so that only a portion of the site is exposed at any one time. Also, disturbed areas that are not being actively worked should have temporary cover. Areas that are at final grade should receive permanent cover as soon as possible.

Problem #2—No sediment controls on-site

Sediment controls such as silt fences, sediment barriers, sediment traps and basins must be in place before soil-disturbance activities begin. Don't proceed with grading work out-of-phase.

Problem #3—No sediment control for temporary stockpiles

Temporary stockpiles must be seeded, covered, or surrounded by properly installed silt fence. Stockpiles should never be placed on paved surfaces.

Problem #4—No inlet protection

All storm drain inlets that could receive a discharge from the construction site must be protected before construction begins and must be maintained until the site is finally stabilized.

Problem #5—No BMPs to minimize vehicle tracking onto the road

Vehicle exits must use BMPs such as stone pads, concrete or steel wash racks, or equivalent systems to prevent vehicle tracking of sediment.

Problem #6—Improper solid waste or hazardous waste management

Solid waste (including trash and debris) must be disposed of properly, and hazardous materials (including oil, gasoline, and paint) must be properly stored (which includes secondary containment). Properly manage portable sanitary facilities.

Problem #7—Dewatering and other pollutant discharges at the construction site

Construction site dewatering from building footings or other sources should not be discharged without treatment. Turbid water should be filtered or allowed to settle.

Problem #8—Poorly managed washouts (concrete, paint, stucco)

Water from washouts must not enter the storm drain system or a nearby receiving water. Make sure washouts are clearly marked, sized adequately, and frequently maintained.

Problem #9—Inadequate BMP maintenance

BMPs must be frequently inspected and maintained if necessary. Maintenance should occur for BMPs that have reduced capacity to treat stormwater (construction general permits or state design manuals often contain information on when BMPs should be maintained), or BMPs that have been damaged and need to be repaired or replaced (such as storm drain inlet protection that has been damaged by trucks).

Problem #10—Inadequate documentation or training

Failing to develop a SWPPP, keep it up-to-date, or keep it on-site, are permit violations. You should also ensure that SWPPP documentation such as a copy of the NOI, inspection reports and updates to the SWPPP are also kept on-site. Likewise, personnel working on-site must be trained on the basics of stormwater pollution prevention and BMP installation/maintenance.

E. Update and Evaluate Your SWPPP

Like your construction site, your SWPPP is dynamic. It is a document that must be amended to reflect changes occurring at the site. As plans and specifications change, those changes should be reflected in your SWPPP. If you find that a BMP is not working and you decide to replace it with another, you must reflect that change in your SWPPP. Document in your SWPPP transitions from one phase of construction to the next, and make sure you implement new BMPs required for that next phase.

Are Your BMPs Working?

You should evaluate the effectiveness of your BMPs as part of your routine inspection

process. An informal analysis of both your inspection's findings and your list of BMP repairs will often reveal an inadequately performing BMP. An inspection immediately after a rain event can indicate whether another approach is needed.

You may decide to remove an existing BMP and replace it with another, or you may add another BMP in that area to lessen the impact of stormwater on the original installation.

When you update your SWPPP, you can simply mark it up, particularly for relatively simple changes and alterations. More significant changes might require a rewriting of portions of the SWPPP. The site map should also be updated as necessary.

Chapter 9: Final Stabilization and Permit Termination

► This chapter describes what you must do to stabilize your construction site and end permit coverage.

Stabilize Disturbed Areas

As your construction project progresses, you must stabilize areas not under construction. EPA and most states have specific requirements and time frames that must be followed. Generally, it is a wise management practice to stabilize areas as quickly as possible to avoid erosion problems that could overwhelm silt fences, sediment basins, and other sediment control devices.

SWPPP Tip!

Stabilize as soon as practicable

EPA's Construction General Permit states that, "stabilization measures must be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased."

Temporary stabilization can be achieved through a variety of BMPs, including mulching, seeding, erosion control blankets, hydroseeding, and other measures.

Permanent or final stabilization of areas on your site is generally accomplished by installing the final landscape requirements (e.g., trees, grass, gardens, or permanent stormwater controls). Once the site has been stabilized, you can terminate your permit coverage.

Sediment controls, such as silt fence, berms, sediment ponds or traps, alone, are not stabilization measures. You should continue to use these kinds of measures (e.g., silt fence around an area that has been seeded) until full stabilization is achieved.

A. Final Stabilization

When you have completed your construction project or an area within the overall project, you must take steps to permanently and finally stabilize it. Check your permit for the specific requirements you must meet. After a project or an area in the project has been fully stabilized, you should remove temporary sediment and erosion control devices (such as silt fences). You might also be able to stop routine inspections in these stabilized areas. However, in some states such as Colorado, inspections are required every 30 days (after the construction has been completed and the site is stabilized) until permit coverage has been terminated. In general, you should be aware that

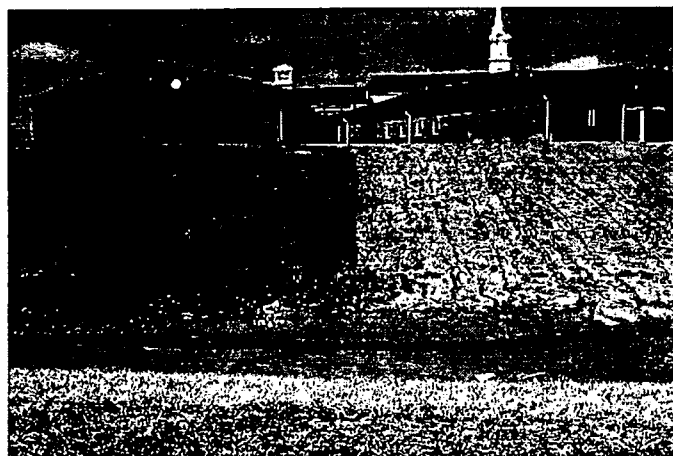


Figure 16. Seeding is an effective BMP that can be used to temporarily or permanently stabilize disturbed areas.

final stabilization often takes time (weeks or even months), especially during times of low rainfall or during the colder months of the year. You should not discontinue routine inspections until you have met the final stabilization requirements in your permit.

EPA and many states define final stabilization as occurring when a uniform, evenly distributed perennial vegetative cover with a density of 70 percent of the native background cover has been established on all unpaved areas and areas not covered by permanent structures. Some states have a higher percentage of vegetative cover required (e.g., New York requires 80 percent). Please review your state's construction general permit for specific requirements.

Native vegetation must be established uniformly over each disturbed area on the site. Stabilizing seven of ten slopes, or leaving an area equivalent to 30 percent of the disturbed area completely unstabilized will not satisfy the *uniform vegetative cover* standard.

The contractor must establish vegetation over the entire disturbed soil area at a minimum density of 70 percent of the native vegetative coverage. For example, if native vegetation covers 50 percent of the undisturbed ground surface (e.g., in an arid or semi-arid area), the contractor must establish 35 percent vegetative coverage uniformly over the entire disturbed soil area ($0.70 \times 0.50 = 0.35$ or 35 percent). Several states require perennial native vegetative cover that is *self-sustaining* and capable of providing *erosion control equivalent to preexisting conditions* to satisfy the 70 percent coverage requirement.

In lieu of vegetative cover, you can apply alternate measures that provide equivalent soil stabilization to the disturbed soil area. Such equivalent measures include blankets, reinforced channel liners, soil cement, fiber matrices, geotextiles, or other erosion-resistant soil covering or treatments. Your construction general permit might allow all or some of these alternate measures for equivalent soil stabilization for final stabilization; check your general permit.

B. Permit Termination

Once construction activity has been completed and disturbed areas are finally stabilized, review your general permit for specific steps to end your coverage under that permit. EPA and many states require you to submit a form, often called a notice of termination (NOT), to end your coverage under that construction general permit. Before terminating permit coverage, make sure you have accomplished the following:

- Remove any construction debris and trash
- Remove temporary BMPs (such as silt fence). Remove any residual sediment as needed. Seed and mulch any small bare spots. BMPs that will decompose, including some fiber rolls and blankets, may be left in place
- Check areas where erosion-control blankets or matting were installed. Cut away and remove all loose, exposed material, especially in areas where walking or mowing will occur. Reseed all bare soil areas
- Ensure that 70 percent of background native vegetation coverage or equivalent stabilization measures have been applied for final soil stabilization of disturbed areas
- Repair any remaining signs of erosion
- Ensure that post-construction BMPs are in place and operational. Provide written maintenance requirements for all post-construction BMPs to the appropriate party
- Check all drainage conveyances and outlets to ensure they were installed correctly and are operational. Inspect inlet areas to ensure complete stabilization and remove any brush or debris that could clog inlets. Ensure banks and ditch bottoms are well vegetated. Reseed bare areas and replace rock that has become dislodged
- Seed and mulch or otherwise stabilize any areas where runoff flows might converge or high velocity flows are expected
- Remove temporary stream crossings. Grade, seed, or re-plant vegetation damaged or removed
- Ensure subcontractors have repaired their work areas before final closeout

You might also be required to file an NOT if you transfer operational control to another

Take a Closer Look...

Is there a deadline to submit an NOT?

Many states require a Notice of Termination (NOT) or similar form to indicate that the construction phase of a project is completed and that all the terms and conditions have been met. This notification informs the permitting authority that coverage under the construction general permit is no longer needed. If your permitting authority requires such a notification, check to see what conditions must be met in order to submit it and check to see if there is a deadline for submission. EPA's Construction General Permit requires that you submit an NOT when you have met all your permit requirements. The NOT is due no later than 30 days after meeting these requirements.

What does this mean to me?

Check your permit carefully for details and conditions relating to terminating your permit coverage.

party before the project is complete. The new operator would be required to develop and implement a SWPPP and to obtain permit coverage as described above.

EPA and most states allow homebuilders to terminate permit coverage when the property has been transferred to the homeowner with temporary or final stabilization measures in place. If the transfer is made with temporary stabilization measures in place, EPA expects the homeowner to complete the final landscaping. Under these circumstances, EPA and most states do not require homeowners to develop SWPPPs and apply for permit coverage.

C. Record Retention

EPA's regulations specifies that you must retain records and reports required in the permit, including SWPPPs and information used to complete the NOI, for at least 3 years from the termination of coverage or expiration of the permit. You should also keep maintenance and inspection records related to the SWPPP for this same time frame. General permits issued by states may have a longer period for retention.



Figure 17. Make sure inlets, outlets, and slopes are well stabilized before leaving the site and filing your "Notice of Termination" for ending permit coverage.

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Appendix A: **SWPPP Template**

An electronic copy of the SWPPP template is available on EPA's web site at:
<http://www.epa.gov/npdes/swpppguide>

Appendix B: Sample Inspection Report

An electronic copy of the sample inspection report is available on EPA's web site at:
<http://www.epa.gov/npdes/swpppguide>

Appendix C: Calculating the Runoff Coefficient

The following information is largely taken from EPA's 1992 guidance *Stormwater Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices* (EPA 832-R-92-005).

It is important to estimate your development's impact on runoff after construction is complete. This can be done by estimating the runoff coefficient for pre- and post-construction conditions. The runoff coefficient ("C" value) is the partial amount of the total rainfall which will become runoff. The runoff coefficient is used in the "rational method" which is:

$$Q = CiA,$$

Where Q = the rate of runoff from an area,
i = rainfall intensity, and
A = the area of the drainage basin.

There are many methods which can be used to estimate the amount of runoff from a construction site. You are not required to use the rational method to design stormwater conveyances or BMPs. Consult your State/local design guides to determine what methods to use for estimating design flow rates from your development.

The less rainfall that is absorbed (infiltrates) into the ground, evaporates, or is otherwise absorbed on site, the higher the "C" value. For example, the "C" value of a lawn area is 0.2, which means that only 20 percent of the rainfall landing on that area will run off, the rest will be absorbed or evaporate. A paved parking area would have a "C" value of 0.9, which means that 90 percent of the rainfall landing on that area will become runoff. You should calculate the runoff coefficient for conditions before construction and after construction is complete. It is suggested that a runoff coefficient be calculated for each drainage basin on the site. The following is an example of how to calculate the "C" value.

The runoff coefficient or "C" value for a variety of land uses may be found in Table C-1 (NOTE: Consult your State/local design guide, if available, to determine if specific "C" values are specified for your area). The "C" values provide an estimate of anticipated runoff for particular land uses. Most sites have more than one type of land use and therefore more than one "C" value will apply. To have a "C" value that represents your site you will need to calculate a "weighted C value."

Calculating a "Weighted C value"

When a drainage area contains more than one type of surface material with more than one runoff coefficient a "weighted C" must be calculated. This "weighted C" will take into account the amount of runoff from all the various parts of the site. A formula used to determine the "weighted C" is as follows:

$$C = \frac{A_1C_1 + A_2C_2 + \dots + A_xC_x}{(A_1 + A_2 + \dots + A_x)}$$

Where A = acres and C = coefficient.

Therefore, if a drainage area has 15 acres (ac.) with 5 paved acres (C = 0.9), 5 grassed acres (C = 0.2), and 5 acres in natural vegetation (C = 0.1), a "weighted C" would be calculated as follows:

$$C = \frac{(5 \text{ ac} \times 0.9) + (5 \text{ ac} \times 0.2) + (5 \text{ ac} \times 0.1)}{(5 \text{ ac} + 5 \text{ ac} + 5 \text{ ac})} = 0.4$$

Table C-1. Typical "C" Values

Description of Area	Runoff Coefficients
Business	
Downtown Areas	0.70 – 0.95
Neighborhood Areas	0.50 – 0.70
Residential	
Single-family areas	0.30 – 0.50
Multi-units, detached	0.40 – 0.60
Multi-units, attached	0.60 – 0.75
Residential (suburban)	0.25 – 0.40
Apartment dwelling areas	0.50 – 0.70
Industrial	
Light Areas	0.50 – 0.80
Heavy Areas	0.60 – 0.90
Parks, cemeteries	0.10 – 0.25
Playgrounds	0.20 – 0.35
Railroad yard areas	0.20 – 0.40
Unimproved areas	0.10 – 0.30
Streets	
Asphalt	0.70 – 0.95
Concrete	0.80 – 0.95
Brick	0.70 – 0.85
Drives and Walks	0.75 – 0.85
Roofs	0.75 – 0.95
Lawns – coarse textured soil (greater than 85% sand)	
Slope: Flat, 2%	0.05 – 0.10
Average, 2-7%	0.10 – 0.15
Steep, 7%	0.15 – 0.20
Lawns – fine textured soil (greater than 40% clay)	
Slope: Flat, 2%	0.13 – 0.17
Average, 2-7%	0.18 – 0.22
Steep, 7%	0.25 – 0.35

Appendix D: Resources List

The following are just a few of the many resources available to assist you in developing your SWPPP. The inclusion of these resources does not constitute an endorsement by EPA.

EPA Resources

EPA Stormwater Construction Website

<http://www.epa.gov/npdes/stormwater/construction>

- EPA's Construction General Permit (<http://www.epa.gov/npdes/stormwater/cgp>)
EPA's general permit that applies to all construction activity disturbing greater than one acre in the states and territories where EPA is the permitting authority.
- Construction SWPPP Guide, SWPPP Template and inspection form (www.epa.gov/npdes/swpppguide)
A downloadable copy of this guide, the SWPPP template and inspection form.
- Menu of BMPs (<http://www.epa.gov/npdes/stormwater/menuofbmps>)
Site containing over 40 construction BMP fact sheets. Also contains fact sheets on other stormwater program areas, and case studies organized by program area.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas

<http://www.epa.gov/owow/nps/urbanmm/index.html>

Managing Your Environmental Responsibilities: A Planning Guide for Construction and Development

<http://epa.gov/compliance/resources/publications/assistance/sectors/constructmyer.html>

Expedited Settlement Offer Program for Stormwater (Construction)

<http://www.epa.gov/compliance/resources/policies/civil/cwa/esoprogstormwater.pdf>

A supplemental program to ensure consistent EPA enforcement of stormwater requirements at construction sites for relatively minor violations.

Construction Industry Compliance Assistance

<http://www.cicacenter.org>

Plain language explanations of environmental rules for the construction industry. Links to stormwater permits and technical manuals for all 50 states.

Smart Growth and Low Impact Development Resources

Using Smart Growth Techniques as Stormwater Best Management Practices

http://www.epa.gov/livablecommunities/pdf/sg_stormwater_BMP.pdf

Stormwater Guidelines for Green, Dense Development

http://www.epa.gov/smartgrowth/pdf/Stormwater_Guidelines.pdf

Protecting Water Resources with Smart Growth

http://www.epa.gov/smartgrowth/pdf/waterresources_with_sg.pdf

Parking Spaces / Community Places: Finding the Balance Through Smart Growth Solutions

<http://www.epa.gov/smartgrowth/parking.htm>

EPA Nonpoint Source Low Impact Development site

<http://www.epa.gov/owow/nps/lid/>

Better Site Design: A Handbook for Changing Development Rules in Your Community

Available from <http://www.cwp.org>

State BMP/Guidance Manuals

Kentucky Erosion Prevention and Sediment Control Field Guide

<http://www.water.ky.gov/permitting/wastewaterpermitting/KPDES/storm/>

Easy to read field guide describing erosion and sediment control BMP selection, installation and maintenance.

Minnesota Stormwater Construction Inspection Guide

<http://www.pca.state.mn.us/publications/wq-strm2-10.pdf>

A manual designed to assist municipal construction inspectors in the procedures for conducting a compliance inspection at construction sites.

California Stormwater Quality Association's Construction Handbook

<http://www.cabmphandbooks.org/Construction.asp>

Delaware Erosion and Sediment Control Handbook

<http://www.dnrec.state.de.us/dnrec2000/Divisions/Soil/Stormwater/StormWater.htm>

Western Washington Stormwater Management Manual – Volume II – Construction Stormwater Pollution Prevention

<http://www.ecy.wa.gov/programs/wq/stormwater/manual.html>

Eastern Washington Stormwater Management Manual

<http://www.ecy.wa.gov/biblio/0410076.html>

A guidance document addressing stormwater design and management in more arid climates.

Certification Programs

Certified Professional in Erosion and Sediment Control

<http://www.cpesc.org>

Virginia Erosion and Sediment Control Certification Program

<http://www.dcr.virginia.gov/sw/estr&crt2.htm>

Florida Stormwater, Erosion and Sedimentation Control Inspector Certification

<http://www.dep.state.fl.us/water/nonpoint/erosion.htm>

Other Resources

International Erosion Control Association

<http://www.ieca.org>

A non-profit organization helping members solve the problems caused by erosion and its byproduct—sediment.

Erosion Control Magazine

<http://www.erosioncontrol.com>

A journal for erosion and sediment control professionals.

Designing for Effective Sediment & Erosion Control on Construction Sites by Jerald S. Fifield, PH.D., CPESC.

Available from Forester Press

<http://www.foresterpress.com>

Book describing proven and practical methods for minimizing erosion and sedimentation on construction sites.

Stormwater Permitting: A Guide for Builders and Developers by National Association of Home Builders (NAHB).

Available from NAHB <http://www.nahb.org>

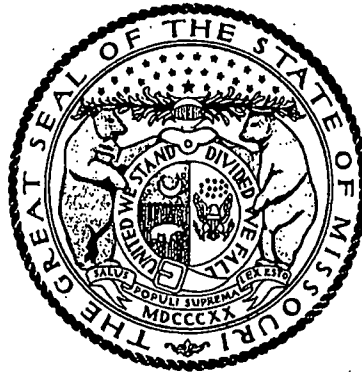
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Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



JEREMIAH W. (JAY) NIXON, Governor

Annual Wage Order No. 23

Section 110
TANEY COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by

John E. Lindsey, Director
Division of Labor Standards

This Is A True And Accurate Copy Which Was Filed With The Secretary of State: March 10, 2016

Last Date Objections May Be Filed: April 11, 2016

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	** Date of Increase	*	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Asbestos Worker (H & F) Insulator			\$14.50	FED		\$3.65
Boilermaker	7/16		\$35.93	57	7	\$28.33
Bricklayer and Stone Mason	6/16		\$27.73	24	74	\$16.44
Carpenter	6/16		\$24.73	61	4	\$15.65
Cement Mason			\$22.00	FED		\$5.52
Communication Technician			\$16.00	FED		\$0.62
Electrician (Inside Wireman)			\$20.94	21	48	\$11.45 + 10%
Electrician (Outside-Line Construction\Lineman)			\$41.52	125	65	\$5.00 + 34.5%
Lineman Operator			\$38.37	125	65	\$5.00 + 34.5%
Groundman			\$26.76	125	65	\$5.00 + 34.5%
Elevator Constructor	7/16	a	\$44.515	26	54	\$31.531
Glazier	9/16		\$23.35	36	52	\$6.71
Ironworker	6/16		\$29.00	50	4	\$28.45
Laborer (Building):						
General	6/16		\$21.28	112	4	\$11.73
First Semi-Skilled	6/16		\$23.42	112	4	\$11.73
Second Semi-Skilled	6/16		\$21.96	112	4	\$11.73
Lather	6/16		\$24.73	61	4	\$15.65
Linoleum Layer and Cutter	6/16		\$24.63	123	78	\$15.65
Marble Mason			\$21.66	124	74	\$12.68
Marble Finisher			\$14.14	124	74	\$9.08
Millwright	6/16		\$24.73	61	4	\$15.65
Operating Engineer						
Group I	6/16		\$26.34	84	4	\$12.69
Group II			\$22.00	FED		\$7.91
Group III	6/16		\$23.89	84	4	\$12.69
Group III-A	6/16		\$24.60	84	4	\$12.69
Group IV						
Group V	6/16		\$15.80	84	4	\$12.69
Painter	6/16		\$22.00	7	14	\$12.40
Pile Driver	6/16		\$24.73	61	4	\$15.65
Pipe Fitter	11/16		\$29.55	19	1	\$14.82
Plasterer			\$23.53	64	4	\$10.55
Plumber	11/16		\$29.55	19	1	\$14.82
Rofer \ Waterproofer	6/16		\$22.75	10	2	\$10.88
Sheet Metal Worker	7/16		\$28.94	4	24	\$14.18
Sprinkler Fitter - Fire Protection	7/16		\$33.49	33	19	\$19.45
Terrazzo Worker			\$28.73	124	74	\$14.38
Terrazzo Finisher			\$18.68	124	74	\$14.38
Tile Setter			\$21.66	124	74	\$12.68
Tile Finisher			\$14.14	124	74	\$9.08
Traffic Control Service Driver			\$16.35	48	49	\$2.75
Truck Driver-Teamster						
Group I			\$19.45	98	4	\$4.72
Group II						
Group III			\$19.45	98	4	\$4.72
Group IV			\$19.45	98	4	\$4.72

Fringe Benefit Percentage is of the Basic Hourly Rate

**Annual Incremental Increase

Section 110

* Welders receive rate prescribed for the occupational title performing operation to which welding is incidental.

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

a - Vacation: Employees over 5 years - 8% under 5 years 6%

**REPLACEMENT PAGE
TANEY COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 4: Means the regular working day shall consist of eight (8) hours labor on the job between six (6) a.m. and six-thirty (6:30) p.m. and the work week shall consist of five (5) consecutive eight (8) hour days beginning on Monday and ending with Friday of each week. All full time or part time labor performed during such hours shall be recognized as regular working hours and paid for at the regular hourly rate. Also, there may be a 40-hour work week which would consist of ten (10) hours each day for Monday, Tuesday, Wednesday, Thursday or Friday. The first two (2) hours performed in excess of an eight (8) hour workday, Monday through Friday, and the first ten (10) hours on Saturday, shall be paid at one and one half (1½) times the regular rate of pay. All work performed on Sundays and Holidays and in excess of ten (10) hours a day on all days shall be paid at two (2) times the regular rate of pay. A make-up day may be scheduled for work missed due to inclement weather. The make-up hours shall be paid at the regular hourly rate of pay.

NO. 7: Means work between the hours of 7:00 a.m. and 6:00 p.m. daily, Monday through Saturday, as assigned by the Employer shall be considered regular hours. Weekend work shall be paid at the rate of one and one-half (1 ½) times the regular rate of pay. Weekend begins 12:01 a.m. Saturday. Overtime is time worked over forty (40) hours per pay period, and shall be paid at the rate of one and one-half (1½) times the regular rate of pay. Sunday and Holidays will be paid at the rate of two (2) times the regular rate of pay.

NO. 10: Means the regular working day shall be scheduled to consist of at least eight (8) hours but no more than ten (10) consecutive hours, exclusive of the lunch period, unless otherwise provided. Crews shall be scheduled to commence at any time between the hours of 5:00 a.m. and 10:00 a.m. or earlier if agreed on by the majority of any one crew. Except as specifically provided for Saturdays, Sundays and holidays, all work performed by Employees anywhere in excess of forty (40) hours in one (1) work week, or in excess of ten (10) hours in one work day shall be paid at the rate of one and one-half (1½) times the regular hourly wage scale. Any work performed on a Saturday shall be paid at the rate of one and one-half (1½) times the regular hourly wage scale unless such Saturday work falls under the category of Saturday make Up Day. When this Saturday Make Up Day does occur, the Employee may work on Saturday at straight time; provided, however, if during the period worked by said Employee on Saturday, the Employee's compensable time at the straight time rate exceeds forty (40) hours, all time worked in excess of the forty (40) hours will be paid at the rate of one and one-half (1½) time the regular hourly wage scale. The provision of this Saturday Make Up Day shall not apply to any weeks in which a designated holiday is recognized. Any work performed by Employees anywhere on Sunday or holidays shall be paid at the rate of double (2) time the regular wage scale.

NO. 19: On single shift operation, eight (8) hours of work, between 8:00 a.m. and 4:30 p.m., shall constitute a day's work. Forty (40) hours of work Monday through Friday shall constitute a workweek. The starting time may be changed to begin between the hours of six (6:00) and ten (10:00) a.m. The first two (2) hours performed in excess of an eight (8) hour workday Monday through Friday, and the first ten (10) hours on Saturday, shall be paid at time and one-half (1.5) the basic straight-time rate. All work performed on Sundays and holidays, and in excess of ten (10) hours a day shall be paid at double (2) the basic straight time rate of pay. When hours worked are outside of established work hours, the pay rate shall be one and one-half (1.5) times the regular rate of pay for the first ten (10) hours, and all hours in excess of ten (10) hours shall be at the double-time rate. Shift work of either one (1) eight hour night shift, or two (2) eight (8) hour night shifts on a job which will continue for at least one (1) week, all employees shall be paid eighteen and one-half percent (18.5%) over the straight-time hourly rate on the night shifts. All hours worked in excess of eight (8) in a shift shall be paid at the applicable overtime rate of pay. The normal workweek may be changed to four (4) ten (10) hour days or four (4) ten (10) hour nights, if on shift work, with the following provisions: Monday through Thursday would be the normal workweek with Friday being used as scheduled workday in case of a day being lost due to weather, all employees working night shift, on a job that will continue at least one (1) week, shall be paid thirty percent (30%) over the regular straight-time hourly rate of pay, and any hours worked before or after established starting and quitting times being paid at double (2) time hourly rates of pay.

**REPLACEMENT PAGE
TANEY COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 21: Means eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within five (5) days, Monday through Friday, shall constitute a work week. The regular starting time of a job may be moved not more than two (2) hours prior to 8:00 a.m. However, in no case shall more than eight (8) hours be worked per day without the applicable overtime rate being paid. When job conditions dictate, the Employer shall be allowed to establish a four (4) day, ten (10) hours per day work week. This work week is defined as Monday through Thursday or Tuesday through Friday. All hours worked in excess of ten (10) hours per day or forty (40) hours per week shall be paid at the applicable overtime rate. This language is not intended to change the normal five (5) day, eight (8) hour per day work week. All overtime work performed after the regularly scheduled working hours Monday through Friday and Saturday shall be paid for at time and one-half (1½) the regular straight time rate of pay. Sundays and recognized holidays shall be paid for at two (2) times the straight time rate of pay. Shift work performed between the hours of 4:30 p.m. and 1:00 a.m. (second shift) shall receive eight (8) hours pay at the regular hourly rate of pay plus 17.3% for all hours worked. Shift work performed between the hours of 12:30 a.m. and 9:00 a.m. (third shift) shall receive eight (8) hours pay at the regular hourly rate of pay plus 31.4% for all hours worked. An unpaid lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required before the established start time and after the completion of eight (8) hours of any shift shall be paid at one and one-half (1½) times the shift hourly rate.

NO. 24: Means eight (8) hours shall constitute a day's work on all classes of work between the hours of 6:00 a.m. and 5:30 p.m., Monday through Friday. The pay for time worked during these hours shall be at the regular wage rate. The regular workweek shall be Monday through Friday. A workweek of four (4), ten (10) hour days may be established on a per job basis. Saturday may be used for a make-up day, when working 5-8's, Friday when working 4-10's. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid for at the rate of time and one-half (1½) except after eight (8) hours worked, then double (2) time will apply. All time worked on Sundays and the recognized holidays shall be paid at the rate of double (2) time.

NO. 26: Means that the regular working day shall consist of eight (8) hours worked between 6:00 a.m., and 5:00 p.m., five (5) days per week, Monday to Friday, inclusive. Hours of work at each jobsite shall be those established by the general contractor and worked by the majority of trades. (The above working hours may be changed by mutual agreement). Work performed on Construction Work on Saturdays, Sundays and before and after the regular working day on Monday to Friday, inclusive, shall be classified as overtime, and paid for at double (2) the rate of single time. The employer may establish hours worked on a jobsite for a four (4) ten (10) hour day work week at straight time pay for construction work; the regular working day shall consist of ten (10) hours worked consecutively, between 6:00 a.m. and 6:00 p.m., four (4) days per week, Monday to Thursday, inclusive. Any work performed on Friday, Saturday, Sunday and holidays, and before and after the regular working day on Monday to Thursday where a four (4) ten (10) hour day workweek has been established, will be paid at two times (2) the single time rate of pay. The rate of pay for all work performed on holidays shall be at two times (2) the single time rate of pay.

NO. 33: Means the standard work day and week shall be eight (8) consecutive hours of work between the hours of 6:00 a.m. and 6:00 p.m., excluding the lunch period Monday through Friday, or shall conform to the practice on the job site. Four (4) days at ten (10) hours a day may be worked at straight time, Monday through Friday and need not be consecutive. All overtime, except for Sundays and holidays shall be at the rate of time and one-half (1½). Overtime worked on Sundays and holidays shall be at double (2) time.

NO. 36: Means eight (8) hours shall constitute a work day, Monday through Friday between the hours of 6:00 a.m. and 6:00 p.m. Saturday can be used as a makeup day if time is lost due to weather. All hours in excess of the regular forty (40) hour work week or eight (8) hours per day shall be considered overtime and shall be paid for at the rate of one and one-half (1½) times the regular rate. Employees will be paid at the rate of one and one-half (1½) times their regular rate for work performed on Saturdays. Sundays and holidays worked are to be paid at double (2) the regular hourly rate. Four (4) ten-hour days, at the option of the Employer, shall be the standard work week, consisting of a consecutive ten-hour period, Monday through Thursday or Tuesday through Friday, between the hours of 6:00 a.m. and 6:00 p.m. Forty (40) hours per week shall constitute a week's work.

**REPLACEMENT PAGE
TANEY COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 48: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 50: Means eight (8) hours constitute a normal day's work Monday through Friday. Any time worked over eight (8) hours will normally be paid at time and one-half (1½) except for exclusions stated in some following additional sentences. The Employer, at his discretion, may start the work day between 6:00 a.m. and 9:00 a.m. Any schedule chosen shall be started at the beginning of the work week (Monday) and used for at least five days. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule. If such a schedule is employed, then Friday may be used as a make-up day when time is lost due to inclement weather. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any regular work day Monday through Friday unless working 4-10's, then time and one-half (1½) after ten (10) hours. All work performed on Saturday will be time and one-half (1½). Double (2) time shall be paid for all work on Sundays and recognized holidays.

NO. 57: Means eight (8) hours per day shall constitute a day's work and forty (40) hours per week, Monday through Friday, shall constitute a week's work. The regular starting time shall be 8:00 a.m. If a second or third shift is used, the regular starting time of the second shift shall be 4:30 p.m. and the regular starting period for the third shift shall be 12:30 a.m. These times may be adjusted by the employer. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional \$0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional \$0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. When circumstances warrant, the Employer may change the regular workweek to four (4) ten-hour days at the regular time rate of pay. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid at the rate of time and one-half (1½) except in cases where work is part of an employee's regular Friday shift. All time worked on Sunday and recognized holidays shall be paid at the double (2) time rate of pay except in cases where work is part of an employee's previous day's shift. For all overtime hours worked \$27.04 of the fringe benefits portion of the prevailing wage shall be paid at the same overtime rate at which the cash portion of the prevailing wage is to be paid. The remaining \$1.29 of the fringe benefit portion of the prevailing wage may be paid at straight time.

NO. 61: Means except as herein provided, eight (8) hours a day, 8:00 a.m. to 4:30 p.m., shall constitute a standard work day, and forty (40) hours per week shall constitute a week's work. The regular workday starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (1½). All time worked on Sunday and holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) day ten hour work week is in effect, the standard work week shall consist of forty (40) hours, Monday through Friday, which will consist of any four (4) consecutive ten-hour four days within the five (5) day period. In the event the job is down for any reason beyond the control of the Employer, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours per day, or forty (40) hours per week. When the five (5) day eight-hour work week is in effect, forty (40) hours per week shall constitute a week's work (normal work week being Monday through Friday). In the event the job is down for any reason beyond the control of the Employer, then Saturday may, at the option of the Employer, be worked as a make-up day, at straight time not to exceed eight (8) hours for that day, or forty (40) hours per week. A make-up day is not to be used to make up time lost due to recognized holidays.

**REPLACEMENT PAGE
TANEY COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 64: Means eight (8) hours shall constitute a day's work beginning at 8:00 a.m. and ending at 4:30 p.m. Forty (40) hours shall constitute a week's work, Sunday through Saturday. In the event time is lost due to weather or conditions beyond the control of the Employer, the Employer may schedule work on Saturday at straight time. All work over eight (8) hours in one day, forty (40) hours in one week, or on Saturday (except as herein provided) shall be classified as overtime and be paid at the rate of time and one-half (1½). All work on Sunday or recognized holidays shall be classified as overtime and be paid at the rate of double (2) time. When the four (4) day ten-hour work week is in effect, the standard work day shall be consecutive ten (10) hour periods. Forty (40) hours per week shall constitute a week's work Sunday through Saturday inclusive. In the event the job is down for reasons beyond the contractors control, then Friday and/or Saturday may, at the option of the Employer be worked as a make-up day, straight time not to exceed ten (10) hours per day or forty (40) hours per week.

NO. 84: The regular working starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. Except as provided in this Article, eight (8) hours a day shall constitute a standard work day and forty (40) hours per week shall constitute a weeks' work, which shall begin on Sunday and end on Saturday. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid at the rate of time & one-half (1½) (except as herein provided). All time worked on Sunday and recognized holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) ten-hour work week is in effect, the standard work day shall be consecutive ten (10) hour periods, exclusive of the lunch period, beginning at 6:30 a.m. and forty (40) hours per week shall constitute a week's work, Monday through Thursday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours or forty (40) hours per week. When the five (5) eight-hour work week is in effect, forty (40) hours per week shall constitute a week's work, Monday through Friday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed eight (8) hours or forty (40) hours per week.

NO. 98: Means eight (8) hours a day shall constitute a standard work day, and forty (40) hours per week shall constitute a week's work which shall begin on Sunday and end on Saturday. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (1½) (except as herein provided). All time worked on Sunday and recognized holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) ten-hour work week is in effect, the standard work day shall be consecutive ten (10) hour periods between the hours of 5:30 and 6:30 a.m. and 6:30 p.m. Forty (40) hours per week shall constitute a week's work, Monday through Thursday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day; straight time not to exceed ten (10) hours per day or forty (40) hours per week. When the five (5) day eight (8) hours work week is in effect forty (40) hours per week shall constitute a week's work, Monday through Friday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Saturday may, at the option of the Employer, be worked as a make-up day; straight time not to exceed eight (8) hours per day or forty (40) hours per week. When the five (5) day eight (8) hour work week is in effect, starting time shall be between 7:00 a.m. and 8:00 a.m. All time worked before 7:00 a.m. shall be paid for at the rate of time and one-half (1½). All work performed on Saturday up to 6:00 p.m. (except as herein provided) shall be compensated for at the rate of time and one-half (1½). All time worked from 6:00 p.m. Saturday to 7:00 a.m. Monday will be paid for at the rate of double (2) time.

NO. 112: Means the regular starting time of 8:00 a.m. (and resulting quitting time of 4:30 p.m.) may be moved forward to 6:00 a.m. or delayed one (1) hour to 9:00 a.m. Except as provided for, eight (8) hours a day shall constitute a standard work day, and forty (40) hours per week shall constitute a week's work, which shall begin on Sunday and end on Saturday. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (1½) (except as herein provided). All time worked on Sunday and recognized holidays shall be classified as overtime and paid at the rate of double (2) time. The Employer has the option of working either five (5) eight (8) hour days or four (4) ten (10) hour days to constitute a normal forty (40) hour work week. When the four (4) ten-hour work week is in effect, the standard work day shall be consecutive ten hour periods between the hours of 6:30 a.m. and 6:30 p.m. Forty (40) hours per week shall constitute a week's work, Monday through Thursday, inclusive. In the event the job is down for any reason beyond the Employer's control, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day; straight time not to exceed eight (8) hours or forty (40) hours per week.

**REPLACEMENT PAGE
TANEY COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 123: Means except as provided, eight (8) hours a day (8:00 A.M. to 4:30 P.M.) shall constitute a standard work day, excluding the 30-minute lunch period, and forty (40) hours per week shall constitute a week's work. All time worked outside of the standard work day and on Saturday shall be classified as overtime and paid the rate of time and one-half (except as herein provided). All time worked on Sunday and herein named holidays shall be classified as overtime and paid at the rate of double time. The Employer has the option of working either five (5) eight-hour days or four (4) ten-hour days to constitute a normal forty (40) hour work week. When the four (4) day ten-hour work week is in effect, the standard work week shall consist of forty (40) hours, Monday through Friday, which will consist of any four (4) consecutive ten (10) hour days within the five day period. In the event the job is down for any reason beyond the control of the Employer, then Friday and/or Saturday may, at the option of the Employer, be worked as a make-up day, straight time not to exceed ten (10) hours or forty (40) hours per week. Starting time will be designated by the Employer. When the five (5) day eight (8) hour work week is in effect forty (40) hours per week will constitute a week's work (normal work week being Monday through Friday). In the event the job is down for any reason beyond the control of the Employer, then Saturday may, at the option of the Employer, be worked as a make-up day; at straight time not to exceed eight (8) hours or forty (40) hours per week.

NO. 124: Means eight (8) hours shall constitute a day's work on all classes of work between the hours of 6:00 a.m. and 5:30 p.m., Monday through Friday. The pay for time worked during these hours shall be at the regular wage rate. The regular workweek shall be Monday through Friday. Employment from 4:30 p.m. to 12:00 midnight, Monday through Friday, shall be paid for at one and one-half (1½) times the regular hourly rate. From 12:00 midnight until 8:00 a.m. on any day shall be paid for at twice the regular hourly rate. All time worked on Sundays and the recognized holidays shall be paid at the rate of double (2) time. It is understood that forty (40) hours shall constitute a regular workweek, (5-8's) Sunday Midnight through Friday Midnight, understanding anything over eight (8) hours is one and one-half (1½) times the hourly wage rate.

NO. 125: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

TANEY COUNTY HOLIDAY SCHEDULE – BUILDING CONSTRUCTION

NO. 1: All work done on New Year's Day, Decoration Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the rate of double time. When one of the above holidays falls on Sunday, the following Monday shall be observed. When one of the above holidays falls on Saturday the preceding Friday shall be observed.

NO. 2: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or the days observed as such, shall be paid at the double time rate of pay.

NO. 4: All work done on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas Day shall be paid at the double time rate of pay. If any of the above holidays fall on Sunday, Monday will be observed as the recognized holiday. If any of the above holidays fall on Saturday, Friday will be observed as the recognized holiday and holidays falling on Sunday will be observed on the following Monday.

NO. 7: The following days are assigned days and are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. If a holiday falls on a Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This is applied to protect Labor Day. When a holiday falls during the normal workweek, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week. However, no reimbursement for these eight (8) hours is to be paid to the workman unless worked. If workman are required to work the above enumerated holidays or days observed as such, or on Sunday, they shall receive double (2) the regular rate of pay for such work.

NO. 14: The following days are recognized Holidays: Memorial Day, Fourth of July, Thanksgiving Day, Christmas Day, and New Year's Day. No work shall be done on Labor Day. When falling on a Sunday and the following Monday is observed as part of the holiday, then that Monday shall be considered a holiday. Sunday and Holidays will be paid at the rate of two (2) times the regular rate of pay.

NO. 19: All work done on New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day, and Christmas Day shall be paid at the double time rate of pay. The employee may take off Friday following Thanksgiving Day. However, the employee shall notify his or her Foreman, General Foreman or Superintendent on the Wednesday preceding Thanksgiving Day. When one of the above holidays falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double (2) time rate. When one of the holidays falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double (2) time rate.

NO. 24: All work done on Christmas Day, Thanksgiving Day, New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Presidential Election Day or days locally observed as such, and Sunday shall be recognized as holidays and paid at the double time rate of pay.

NO. 48: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day shall be paid for at double (2) the straight-time rate of pay. Any one of the above-listed holidays falling on Sunday shall be observed on the following Monday and paid for at double (2) the straight-time rate of pay. Any of the above holidays falling on Saturday shall be observed on the previous Friday and paid at double (2) the straight-time rate of pay. Employees working on the Saturday will receive the standard pay for Saturday work.

NO. 49: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 52: All work performed on Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall receive the double (2) time rate of pay.

**TANEY COUNTY
HOLIDAY SCHEDULE – BUILDING CONSTRUCTION**

NO. 54: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day shall be paid at the double (2) time rate of pay. When a holiday falls on Saturday, it shall be observed on Friday. When a holiday falls on Sunday, it shall be observed on Monday.

NO. 65: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 74: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day, shall be paid at double (2) time of the hourly rate of pay. In the event one of the above holiday's falls on Saturday, the holiday shall be celebrated on Saturday. If the holiday falls on Sunday, the holiday will be celebrated on Monday.

NO. 78: The following days shall be recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving and Christmas. If any of the above holidays fall on Sunday, Monday will be observed as the legal holiday. If any of the above holidays fall on Saturday, Friday will be observed as the legal holiday. All time worked on Sunday and herein named holidays shall be classified as overtime and paid at the rate of double time.

OCCUPATIONAL TITLE	* Date of Increase	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Carpenter	6/16	\$29.03	23	16	\$16.10
Electrician (Outside-Line Construction\Lineman)		\$41.52	18	24	\$5.00 + 34.5%
Lineman Operator		\$38.37	18	24	\$5.00 + 34.5%
Lineman - Tree Trimmer		\$21.64	31	30	\$5.00 + 27.5%
Groundman		\$26.76	18	24	\$5.00 + 34.5%
Groundman - Tree Trimmer		\$17.50	31	30	\$5.00 + 27.5%
Laborer					
General Laborer	6/16	\$24.32	4	18	\$12.71
Skilled Laborer	6/16	\$24.87	4	18	\$12.71
Millwright	6/16	\$29.03	23	16	\$16.10
Operating Engineer					
Group I	6/16	\$30.82	5	15	\$13.30
Group II	6/16	\$30.47	5	15	\$13.30
Group III	6/16	\$30.27	5	15	\$13.30
Group IV	6/16	\$28.22	5	15	\$13.30
Oiler-Driver	6/16	\$28.22	5	15	\$13.30
Pile Driver	6/16	\$29.03	23	16	\$16.10
Traffic Control Service Driver		\$16.35	29	28	\$2.75
Truck Driver-Teamster					
Group I	6/16	\$28.24	12	3	\$12.45
Group II	6/16	\$28.40	12	3	\$12.45
Group III	6/16	\$28.39	12	3	\$12.45
Group IV	6/16	\$28.51	12	3	\$12.45

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate sheet.

**REPLACEMENT PAGE
TANEY COUNTY
OVERTIME SCHEDULE - HEAVY CONSTRUCTION**

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1 ½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 4: Means a regular work week shall consist of not more than forty (40) hours of work, Monday through Saturday, and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workers shall receive time and one-half (1½) for all work performed on Sundays and holidays. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer prevent work, in which event, the starting time may be delayed, but not later than 12:00 noon. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward a forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the worker(s) unless worked.

NO. 5: Means a regular work week shall consist of not more than forty (40) hours work, Monday through Saturday, and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workmen shall receive time and one-half (1½) for all work performed on Sundays and recognized holidays or days observed as such. Double (2) time shall be paid for work on Sunday or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or holiday. If a job can't work forty (40) hours, Monday through Saturday, because of inclement weather or other conditions beyond the control of the Employer, Friday and Saturday may be worked as make up days at straight time (if working 4-10's). Saturday may be worked as a make up day at straight time (if working 5-8's). Make up days shall not be utilized for days lost to holidays. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer, including requirements of the owner, prevent work. In such event the starting time may be delayed but not later than 12:00 noon. Where one of the holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours shall be paid at time & one-half (1½).

NO. 12: Means a regular work week shall consist of not more than forty (40) hours of work and all work performed over and above ten (10) hours per day and forty (40) hours per week shall be paid at the rate of time & one-half (1½). A workday is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer, in which event, the starting time may be advanced or delayed. Workers shall receive time and one-half (1½) for all work performed on recognized holidays or days observed as such.

NO. 18: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

**REPLACEMENT PAGE
TANEY COUNTY
OVERTIME SCHEDULE - HEAVY CONSTRUCTION**

NO. 23: Means the regular workweek shall start on Monday and end on Friday, except where the Employer elects to work Monday through Thursday, (10) hours per day. All work over ten (10) hours in a day or forty (40) hours in a week shall be at the overtime rate of one and one-half ($1\frac{1}{2}$) times the regular hourly rate. The regular workday shall be either eight (8) or ten (10) hours. If a job can't work forty (40) hours Monday through Friday because of inclement weather or other conditions beyond the control of the Employer, Friday or Saturday may be worked as a make-up day at straight time (if working 4-10's). Saturday may be worked as a make-up day at straight time (if working 5-8's). An Employer, who is working a four (4) ten (10) hour day work schedule may use Friday as a make-up day when a workday is lost due to a holiday. A workday is to begin at the option of the Employer but not later than 11:00 a.m. except when inclement weather, requirements of the owner or other conditions beyond the reasonable control of the Employer prevent work. Except as worked as a make-up day, time on Saturday shall be worked at one and one-half ($1\frac{1}{2}$) times the regular rate. Work performed on Sunday shall be paid at two (2) times the regular rate. Work performed on recognized holidays or days observed as such, shall also be paid at the double (2) time rate of pay. For all overtime hours worked during the week or on Saturday \$15.55 of the fringe benefits portion of the prevailing wage shall be paid at time and one-half ($1\frac{1}{2}$). For all overtime hours worked on Sundays or recognized holidays \$15.55 of the fringe benefits portion of the prevailing wage shall be paid double time. The remaining \$.55 of the fringe benefit portion of the prevailing wage shall be paid at straight time.

NO. 29: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half ($1\frac{1}{2}$) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half ($1\frac{1}{2}$) unless time has been lost during the week, in which case Saturday will be a make up day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half ($1\frac{1}{2}$) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half ($1\frac{1}{2}$) their regular rate of pay for all hours worked.

NO. 31: Means the overtime rate shall be time and one-half the regular rate for work over forty (40) hours per week. Sundays and Holidays shall be paid at double the straight time rate. All employees performing work on affected properties during or following emergencies shall receive the applicable rate of pay for the first sixteen (16) consecutive hours and all hours worked in excess of sixteen (16) consecutive hours shall be paid at double time until broken by an eight (8) hour rest period. Should an employee be called back to work within two hours of his normal quitting time, the previous hours worked shall count toward the above sixteen (16) hour provision.

**TANEY COUNTY
HOLIDAY SCHEDULE – HEAVY CONSTRUCTION**

NO. 3: The following days are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the workmen unless worked. An Employer working a four (4) day, ten (10) hour schedule may use Friday as a make up day when an observed holiday occurs during the work week. Employees have the option to work that make up day. If workmen are required to work the above enumerated holidays, or days observed as such, they shall receive time & one-half (1½) the regular rate of pay for such work.

NO. 15: The following days are recognized as holidays: New Year's Day, Memorial Day, July Fourth, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. If workmen are required to work the above enumerated holidays or days observed as such, they shall receive time and one-half (1½) the regular rate of pay for such work. Where one of the holidays specified falls or is observed during the workweek, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½). Workmen shall receive time and one-half (1½) for all work performed on Sundays. Double (2) time shall be paid for work on Sunday or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time for that Sunday or holiday.

NO. 16: The following days are recognized as holidays: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week; however, no reimbursement for this eight (8) hours is to be paid to the worker unless worked. If workers are required to work the above recognized holidays or days observed as such, they shall receive double (2) the regular rate of pay for such work.

NO. 18: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the time and one-half (1½) rate of pay. If a holiday falls on Sunday, it shall be observed on the following Monday. If a holiday falls on Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This rule is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward a forty (40) hour week; however no reimbursement for this eight (8) hours is to be paid to the working person(s) unless the holiday is worked.

NO. 24: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 28: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 30: All work performed on New Year's Day, Decoration Day, Fourth of July, Labor Day, Christmas Day, Thanksgiving Day and Day after Thanksgiving or days celebrated for the same.



MISSOURI DEPARTMENT OF CONSERVATION

DESIGN AND DEVELOPMENT DIVISION

Bid Date: January 26, 2017

Bid Time: 2:00 PM

DOCUMENT 004113 – BID FORM

1.1 BID INFORMATION

A. From: Bidder's Name: _____
Address: _____

Herein after called the "**Bidder**".

B. To: Missouri Department of Conservation
Design and Development Division
PO Box 180, 2901 West Truman Blvd.
Jefferson City, MO 65102

herein after called the "**Owner**."

For: SHEPHERD OF THE HILLS FISH HATCHERY
CONSERVATION CENTER REPLACEMENT AND STORAGE
BUILDING IMPROVEMENTS
Taney County, MO

C. Job Number: 56-01-71 and 56-01-64

D. Documents: The undersigned having examined and being familiar with the local conditions affecting the work and with contract documents including the Drawings, Advertisement for Bids, Instructions To Bidders, Statement of Bidders Qualifications, General Conditions, Supplement to General Conditions, and the technical specifications, including:

Addenda number _____ through _____ inclusive

as issued by the Design and Development Division, hereby propose to furnish all labor, materials, equipment, services, etc. required for the performance and completion for the aforementioned work, and hereby proposes to perform the work for the following Base Bid amount as shown on Document 004322 - Unit Prices Form.

- 2.1 MBE/WBE PERCENTAGE OF PARTICIPATION: MBE _____% WBE _____%
NOTE: Projects of \$100,000 or more specific goals are: MBE 10 % and WBE 5 %

- 3.1 BID BOND
Accompanying the bid is: _____ 5% Bid Bond or _____ Cashier's Check/Bank Draft of 5% of base bid, payable without condition to the Missouri Department of Conservation, per Article 5 of "Instructions to Bidders."

4.1 CONTRACT COMPLETION TIME AND LIQUIDATED DAMAGES

- A. The Bidder agrees to complete the work within **Three-Hundered Thirty (330) Working Days** from the date specified in the written "Notice to Proceed." "Working days" shall mean all calendar days except Saturdays, Sundays, and the following holidays: New Year's Day, Martin Luther King Jr., Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day, where in the judgment of the Owner, soil and weather conditions are such as would permit any then major operation of the project. The work shall be performed concurrently. Contractor further agrees to pay, or allow the Missouri Department of Conservation as liquidated damages the sum of ONE THOUSAND SIX HUNDRED Dollars, (\$1,600.00) for each calendar day, including weekends and holidays, that the work remains incomplete.

5.1 ATTACHMENTS TO BID:

- A. 004322 Unit Prices Form
- B. 004412 Contractor, Subcontractors, & Material Suppliers List
- C. 004413 Contractor & Subcontractors Equipment List
- D. 004415 Contractor's Qualifications
- E. 004500 MBE/WBE Compliance Evaluation
- F. 004510 MBE/WBE Eligibility Determination
- G. 004520 MBE/WBE Eligibility Determination - Joint Ventures
- H. 004530 MBE/WBE Application for Waiver
- I. Bid Bond

6.1 BIDDER'S CERTIFICATIONS:

- A. The Bidder agrees to pay not less than the hourly rate of wages as determined by the Department of Labor and Industrial Relations, State of Missouri, in accordance with Section 290.210 to 290.340 as amended RSMO 1978.
- B. The Bidder hereby certifies that this bid is genuine and is not made in the interest of or on behalf of any undisclosed person, firm, or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation;
- That he/she has not directly or indirectly induced or solicited any other bidder to put in a false or sham proposal;
- That he/she has not solicited or induced any person, firm or corporation to refrain from submitting a bid;
- That he/she has not sought by collusion or otherwise to obtain for himself any advantage over any other bidders or over the Owner.
- That he/she will not discriminate against any employee or applicant for employment because of race, creed, color or national origin in the performance of the work.
- That the bidder and its principals are not presently debarred or suspended or otherwise excluded from or ineligible for participation in Federal Assistance Programs.

7.1 DATE:

A. Dated this: _____ day of _____, 20_____.

8.1 SIGNATURES:

Corporation ☐ LLC ☐ Partnership ☐ Individual ☐ Joint Venture ☐

Firm Name: _____

Address _____

Telephone: _____ Fax No. _____

Federal ID No. _____ Social Security No. _____

Incorporated or organized under the laws of the State of: _____
(If a corporation or LLC is organized in a state other than Missouri, Attach Certificate of Authority or Organization to do business in the State of Missouri.)

Corporate Officer Signature

Title of Officer

Typed or Printed Name of Signor

Corporate Secretary's Signature and Seal

Typed or Printed Name of Corporate Secretary

(seal)

LLC Managing Member/Member Signature

Typed or Printed Name of Signor and Title

Partner/Joint Venture Signature

Typed or Printed Name of Signor and Title

Individual(s) Signature

Typed or Printed Name of Signor and Title

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DOCUMENT 004322 – UNIT PRICES FORM**Project Job Number: 56-01-71 and 56-01-64****A. DESCRIPTION:**

It is understood by the undersigned that the quantities given in the following itemized proposal are not guaranteed by the Department of Conservation, and may or may not represent the actual quantities encountered on the job; and that the sum of the products of the quantities listed on the itemized proposal sheet, multiplied by the unit price, shall constitute the base bid. The undersigned offers to do the work whether the final quantities are increased or decreased, at the unit prices stated in the following schedule.

Item	Estimated Quantities	Unit	Unit Bid	Total
PROJECT 1 – Job #56-01-71				
Shepherd of the Hills Fish Hatchery Conservation Center Replacement				
1. Mobilization/Demobilization	1	Lump Sum		\$ _____
2. Site Work	1	Lump Sum		\$ _____
3. Information Sign	1	Lump Sum		\$ _____
4. Full Size Materials Mock-up	1	Lump Sum		\$ _____
5. Construction Survey Staking	1	Lump Sum		\$ _____
6. Soil Erosion Control/SWPPP	1	Lump Sum		\$ _____
7. Conservation Center Replacement	1	Lump Sum		\$ _____
8. Concrete Pavement for Entrance Road and Parking Areas	1	Lump Sum		\$ _____
9. Electrical Site Work	1	Lump Sum		\$ _____
10. Chain Link Fence	1	Lump Sum		\$ _____
PROJECT 1 – BASE BID AMOUNT				\$ _____

(CONTINUED ON NEXT PAGE)

Item	Estimated Quantities	Units	Unit Bid	Total
PROJECT 2 - #56-01-64				
Shepherd of the Hills Fish Hatchery Storage Building improvements				
1. Mobilization/Demobilization	1	Lump Sum		\$ _____
2. Site Work	1	Lump Sum		\$ _____
3. Information Sign	1	Lump Sum		\$ _____
4. Construction Survey Staking	1	Lump Sum		\$ _____
5. Soil Erosion Control/SWPPP	1	Lump Sum		\$ _____
6. Storage Building Construction	1	Lump Sum		\$ _____
7. Road Boring Steel Casing Pipe	101	Linear Foot	\$ _____	\$ _____
8. Water Supply Well Abandonment	1	Lump Sum		\$ _____
9. 6" Water Main and Connections	1	Lump Sum		\$ _____
10. Demolition	1	Lump Sum		\$ _____
PROJECT 2 - BASE BID AMOUNT				\$ _____
TOTAL BASE BID AMOUNT (COMBINED TOTAL OF PROJECT 1 AND 2)				\$ _____

Dollars

Cents

(Written Amount)

DOCUMENT 004412 – CONTRACTOR, SUBCONTRACTORS, & MATERIAL SUPPLIERS LIST
Project Job No. 56-01-71 & 56-01-64

- 1.1 The Bidder hereby certifies that the following Contractor, subcontractors, material suppliers and/or manufacturers will be used in the performance of the work.
- 2.1 Failure to list your firm, subcontractors, or material suppliers for each category of work under the "Description of Work" may be cause for rejection of the bid. If more than one firm performs work in one category, you must designate the portion of work to be performed by each contractor/subcontractor. After bid opening, no substitutes of listed firms will be allowed except as indicated in DOCUMENT 007000 - GENERAL CONDITIONS, Article 23- SUBCONTRACTS.
- 3.1 Also list all MBE/WBE subcontractors and material suppliers performing work. Check the appropriate box for either MBE or WBE. Materials purchased direct from a MBE/WBE manufacturer may be counted as 100% toward the MBE/WBE goal. Failure to meet the MBE/WBE goal set in the Bid Form Document 004113 or to obtain a Waiver of MBE/WBE Participation may be cause for rejection of the bid.

NOTE:

- Use full legal company names as registered with the Missouri Secretary of State's Office
- List MBE/WBE subcontractors and material suppliers even if there is not MBE/WBE goal for the project.
- Fill out additional sheet if necessary.

Name:	Description of Work:	Amount of Bid:	MBE: <input type="checkbox"/>
Address:			WBE: <input type="checkbox"/>
City/State:			
Telephone:			
Name:	Description of Work:	Amount of Bid:	MBE: <input type="checkbox"/>
Address:			WBE: <input type="checkbox"/>
City/State:			
Telephone:			
Name:	Description of Work:	Amount of Bid:	MBE: <input type="checkbox"/>
Address:			WBE: <input type="checkbox"/>
City/State:			
Telephone:			
Name:	Description of Work:	Amount of Bid:	MBE: <input type="checkbox"/>
Address:			WBE: <input type="checkbox"/>
City/State:			
Telephone:			
Name:	Description of Work:	Amount of Bid:	MBE: <input type="checkbox"/>
Address:			WBE: <input type="checkbox"/>
City/State:			
Telephone:			

Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>
Name:	Description of Work:	Amount of Bid:	MBE:
Address:			<input type="checkbox"/>
City/State:			WBE:
Telephone:			<input type="checkbox"/>

Project Job Number: 56-01-71 & 56-01-64

This page is to be filled out in case of any unforeseen time and material required during the project.

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DOCUMENT 004415 – CONTRACTOR'S QUALIFICATIONS

Firm Name _____

Address _____

City _____

State _____

Zip _____

Phone Number _____

Fax No. _____

E-mail Address _____

☐

Corporation

☐

LLC

☐

Partnership

☐

Individual

FOR CORPORATION ONLY:

FEDERAL TAX ID NO. _____

Date of Incorporation _____

Name of State(s) in which Incorporated _____

Certificate No. _____

Date _____

If not incorporated in Missouri, give Certificate of
Authority to do business in Missouri

President's Name _____

Vice President's Name _____

Secretary's Name _____

Treasurer's Name _____

FOR ALL OTHERS (LLC, PARTNERSHIP, INDIVIDUAL):

FEDERAL TAX ID NO. _____

Date of Organization _____

Name of State(s) in which Organized _____

Certificate No. _____

Date _____

If not organized in Missouri, give Certificate of
Organization to do business in Missouri

Printed Name and Title of Person Having Signature Authority

1. _____

Printed Name

Title

2. _____

GENERAL INFORMATION

Percent (%) of work done by Contractor _____

No. of employees _____

No. years in business _____

If you have done business under different name, please give name and location

Has firm ever failed to complete project or defaulted on a contract? If so, state where and why?

Has firm ever been engaged in litigation over any contract? If so, explain

LIST OF COMPLETED PROJECTS WITHIN PAST FIVE YEARS, INCLUDING COST OF EACH AND NAME, PHONE NUMBERS, AND ADDRESS OF OWNER CONTACT:

LIST OF PROJECTS CURRENTLY UNDER CONSTRUCTION, INCLUDING COST OF EACH AND NAME, PHONE NUMBERS, AND ADDRESS OF OWNER CONTACT:

DOCUMENT 004500 - MBE/WBE COMPLIANCE EVALUATION
(For Projects of \$100,000 or More)

This form is to be completed by bidders and submitted to the Missouri Department of Conservation with the bid proposal. A condition for remaining in competition for award is the satisfactory completion of this form for each minority/woman-owned firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for MBE/WBE participation.

1. Project: _____
2. Name of General Contractor: _____
3. Name of MBE/WBE Firm: _____

Designate whether a MBE firm ☐ and/or a WBE firm ☐

Address: _____ Telephone: _____

Type of Business: _____

Officer: _____ Title: _____

4. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):

Base Bid: _____

Alternate(s), (identify separately): _____

5. Dollar amount of contract to be subcontracted to the MBE/WBE Firm:

Base Bid: \$ _____ Alternate(s), (identify separately): _____

6. Is the proposed subcontractor certified as a MBE/WBE firm by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies?

Yes _____ No _____ If yes, provide details. _____

7. If the answer is no to the question above, please attach the information requested in the MBE/WBE Eligibility Determination.

Signature: _____

Name: _____

Title: _____ Date: _____

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DOCUMENT 004510 - MBE/WBE ELIGIBILITY DETERMINATION

(For Projects of \$100,000 or More)

1. Name of firm: _____
2. Designate whether a MBE firm ☐ and/or a WBE firm ☐
3. Address of firm: _____
4. Phone Number of firm: _____
5. Indicate whether firm is sole proprietorship, partnership, joint venture, corporation or other business entity (Please specify): _____
6. Nature of firm's business _____
7. Number of years firm has been in business _____

8. Ownership of firm: Identify those who own 5 percent or more of the firm's ownership. Columns "e" and "f" need be filled out only if the firm is less than 100 percent minority-owned.

a	b	c	d	e	f
Name	Race	Sex	Year of Ownership	Ownership Percentage	Voting Percentage

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

For firms less than 100 percent minority/woman-owned, list the contributions of money, equipment, real estate, or expertise of each of the owners.

9. Control of firm: (a) Identify by name, race, sex, and title those individuals (including owners and non-owners) who are responsible for day-to-day management and policy decision making, including, but not limited to, those with prime responsibility for:

A. Financial decisions _____

(1) Management decisions, such as:

- a. Estimating _____
- b. Marketing and sales _____
- c. Hiring and firing of management personnel _____
- d. Purchases of field operations _____
- e. Supervision of field operations _____

10. For each of those listed in question 8, provide a brief summary of the person's experience and number of years with the firm, indicating the person's qualifications for the responsibilities given him or her.

11. Describe or attach a copy of any stock options or other ownership options that are outstanding, and any agreements between owners or between owners and third parties which restrict ownership or control of minority owners.

12. Identify any owner (see Item 7) or management official (see Item 8) of the named firm who is or has been an employee of another firm that has an ownership interest in or a present business relationship with the named firm. Present business relationships include shared space, equipment, financing, or employees as well as both firms having some of the same owners.

13. What are the gross receipts of the firm for each of the last two years?

Year ending _____ \$ _____
Year ending _____ \$ _____

14. Name, address and telephone number of bonding company, if any:

Bonding limits: _____ Source of letters of credit, if any _____

15. Are you authorized to do business in the State of Missouri as well as locally, including all necessary business licenses?

16. Indicate if this firm or other firms with any of the same officers have previously received or been denied certification or participation as an MBE/WBE and describe the circumstances. Indicate the name of the certifying authority and the date of such certification or denial.

Affidavit

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of _____ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Missouri Department of Conservation current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements:"

Note: If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted; you must inform the Missouri Department of Conservation of the change either through the prime contractor or directly.

Signature _____

Name _____

Date _____

Corporate Seal (where appropriate)

Date _____

State of _____

County of _____

On this _____ day of _____, 20____, before me appeared (name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) _____ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

Notary Public _____

Commission expires _____

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DOCUMENT 004520 - MBE/WBE ELIGIBILITY DETERMINATION - JOINT VENTURES
(For Projects of \$100,000 or More)

This form need not be filled in if each of the firms in the joint venture is minority/woman-owned.

1. Name of Joint venture _____
2. Designate whether a MBE firm ☐ and/or a WBE firm ☐
3. Address of firm _____
4. Phone number of joint venture _____
5. Identify the firms which comprise the joint venture. (The MBE partner must complete the MBE/WBE Eligibility Determination) _____
 - (a.) Describe the role of the MBE firm in the joint venture.

 - (b.) Describe very briefly the experience and business qualifications of each non MBE/WBE co-venturer.

6. Nature of the joint venture's business aimed percentage of MBE/WBE ownership?

7. What is the claimed percentage of MBE/WBE ownership?

8. Ownership of joint venture. Attach a copy of the joint venture agreement. (The following need not be filled in if described in the joint venture agreement)

 - (a.) Description of profit and loss sharing.

 - (b.) Description of capital contributions, including equipment.

 - (c.) Description of other applicable ownership interests.

9. Control of and participation in this contract. Identify by name, race, sex, and "firm" those individuals (and their titles) who are responsible for day-to-day management and policy decision-making, including, but not limited to, those with prime responsibility for:

- a. Financial decisions _____
- b. Management decisions, such as:
 - 1. Estimating _____
 - 2. Marketing and sales _____
 - 3. Hiring and firing of management personnel _____
 - 4. Purchasing of Major items or supplies _____

NOTE - If after filing this information and before the completion of the joint venture's work on the contract covered by this regulation there is any significant change in the information submitted, the joint venture must inform the Missouri Department of Conservation, either directly or through the prime contractor.

AFFIDAVIT

"The undersigned swear that the foregoing statements are correct and include all material and information necessary to identify and explain the terms and operation of our joint venture and the intended participation by each joint venturer in the undertaking. Further, the undersigned covenant and agree to provide the Missouri Department of Conservation current, complete and accurate information regarding actual joint venture work and the payment therefore and any proposed changes in any of the joint venture arrangements and to permit the audit and examination of the books, records, and files of the joint venture, or those of each joint venturer relevant to the joint venture, by authorized representatives of the Missouri Department of Conservation. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under Federal or State laws concerning false statements."

Name of Firm

Name of Firm

Signature

Signature

Name

Name

Title

Title

Date

Date

Date _____

State of _____

County of _____

On this ____ day of _____, 20____, before me appeared (name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission _____
(seal)

Date _____

State of _____

County of _____

On this ____ day of _____, 20____, before me appeared (name) _____ to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm) _____ to execute the affidavit and did so as his or her free act and deed.

Notary Public _____

Commission expires _____
(seal)

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DOCUMENT 004530 – MBE/WBE APPLICATION FOR WAIVER
(For Projects of \$100,000 or More)

This form is to be completed when appropriate and submitted with the bid proposal to the Missouri Department of Conservation. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include minority/woman-owned enterprises as subcontractors. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for MBE/WBE Participation.

1. List pre-bid conferences your firm attended where MBE/WBE requirements were discussed.

2. Identify advertising efforts undertaken by your firm which were intended to recruit potential minority/women subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

3. Note specific efforts to contact in writing those MBE/WBEs capable of and likely to participate as subcontractors for this project.

4. Describe steps taken by your firm to divide work into areas in which MBE/WBE would be capable of performing.

5. What efforts were taken to negotiate with prospective MBE/WBEs for specific sub-bids? Include the names, identify whether MBE and/or WBE, addresses and telephone numbers of MBE/WBEs contacted, a description of the information given to MBE/WBEs regarding the plans and specifications for the assigned work, and a statement as to why additional agreements were not made with MBE/WBEs.

6. List reasons for rejecting a MBE/WBE which has been contacted.

7. Describe efforts your firm may have taken to assist a MBE/WBE in overcoming legal or other requirements which may have to be met.
8. Describe follow-up contacts with MBE/WBEs made by your firm after the initial solicitation.
9. Describe the efforts made by your firm to provide interested MBE/WBEs with sufficiently detailed information about the plans, specifications and requirements of the contract.
10. Describe your firm's efforts to locate MBE/WBEs, identify whether MBE or WBE, not on the directory list and assist MBE/WBEs in becoming certified as such.

Based on the above stated good faith efforts made to locate and supply MBE/WBEs, the bidder hereby requests that the MBE/WBE percentage goal set by this regulation be waived and that the percentage goal for this project be set at

_____ Percent MBE and _____ Percent WBE.

The undersigned hereby certifies having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature: _____

Name: _____

Title: _____

Company: _____

Date: _____



MISSOURI DEPARTMENT OF CONSERVATION DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 005100 – CONSTRUCTION CONTRACT

THIS AGREEMENT, made the (Contract Day) day of (Month of Contract) in the year Two Thousand and Seventeen by and between:

(Contractor's Company Name)

(Company Address 1)

(Company Address 2, Company Address 3)

hereinafter called the "Contractor"

and the MISSOURI DEPARTMENT OF CONSERVATION, hereinafter called the "Owner".

WITNESSETH, that the Contractor and the Owner, for the consideration stated herein agree as follows:

ARTICLE 1. STATEMENT OF WORK

The Contractor shall furnish all labor and materials and perform all work required for furnishing and installing all labor, materials, equipment and transportation and everything necessarily inferred from the general nature and tendency of the plans and specifications for the proper execution of the work for:

Project Name: SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER
REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS,
Taney County, Missouri

Project Job Number: 56-01-71 and 56-01-64

in strict accordance with the Contract Documents as enumerated in Article 7, all of which are made a part hereof.

ARTICLE 2. TIME OF COMPLETION

- A. The work to be performed under this contract shall be commenced in the time specified in a written notice to proceed received from the Owner, and the work covered by this contract shall be completed within **Three-hundered Thirty (330) Working Days, as defined in the General Conditions**, from, and including the date specified in the written order from the Owner instructing the Contractor to commence said work.
- B. Liquidated Savings Specified for Early Completion. The contractor may receive an incentive payment from the Commission, in addition to all other sums earned under the contract, if the contractor completes the construction of the work as stated in Article 1 of Section 005100– Construction Contract. To qualify for this incentive payment, the work must be completed in its entirety, including punch list items. An incentive payment of ONE THOUSAND SIX HUNDRED Dollars (\$1,600.00) will be paid per day for each full day the work is completed prior to the Three-Hundred Thirty (330) Working Days as set forth in Article 2, Paragraph A, of Section 005100 – Construction Contract. The maximum amount paid as liquidated savings will not exceed 2% of the total bid for this work.

- C. In the event of an excusable delay, an extension of the contract completion time will not extend the date specified for determining any liquidated savings or incentive. Further, in the event of an excusable delay, if the contractor completes the work providing for liquidated savings or incentive on or before the Three-Hundred Thirty (330) Working Days as set forth in Article 2, Paragraph A, of Section 005100 – Construction Contract, that shall not constitute a basis to claim acceleration costs in addition to the liquidated savings or incentive that may be earned.
- D. The incentive payment described above is made, not as a bonus or gift, but as stipulated compensation in full for reduced risks, delay and inconvenience experienced by the public, and for other reduced costs to the Commission and public resulting from early completion.

ARTICLE 3. LIQUIDATED DAMAGES

Whenever time is mentioned in this Contract, time shall be and is of the essence of this Contract. The Owner would suffer a loss should the Contractor fail to have the work embraced in this Contract fully completed on or before the time above specified; THEREFORE, in order to adjust satisfactorily the damages on account of such failure, and the parties hereto realizing that it might be impossible to compute accurately or estimate the amount of such loss or damages which the Owner would sustain by reason of failure to complete fully said work within the time required by the Contract, the Contractor hereby covenants and agrees to pay the Owner, as and for liquidated damages, the sum of ONE THOUSAND SIX HUNDRED DOLLARS (\$1,600.00) per day for each and every day, Saturdays, Sundays, National and State holidays excepted, during which the work remains incomplete and unfinished. Any sum which may be due the Owner for such damages shall be deducted and retained by the Owner from any balance which may be due the Contractor when said work shall have been finished and accepted. But such provisions shall not release the Bond of the Contractor from liability according to its terms. In case of failure to complete, the Owner will be under no obligation to show or prove any actual or specific loss or damage.

ARTICLE 4. CONTRACT SUM

The Owner shall pay the Contractor for the prompt, faithful and efficient performance of the conditions and undertakings of the Contract, subject to additions, and deductions as provided herein, in current funds the sum of:

TOTAL CONTRACT AMOUNT: \$ (Total Contract Amount, including any accepted alternates)

UNIT PRICES FORM: The Owner accepts the following Unit Prices Form.

It is understood by the undersigned that the quantities given in the following itemized proposal are not guaranteed by the Department of Conservation, and may or may not represent the actual quantities encountered on the job; and that the sum of the products of the quantities listed on the itemized proposal sheet, multiplied by the unit price, shall constitute the base bid. The undersigned offers to do the work whether the final quantities are increased or decreased, at the unit prices stated in the following schedule.

See attached DOCUMENT 004322 - UNIT PRICES FORM

UNIT PRICES: The Owner accepts the following:

The unit prices include all labor, applicable taxes, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover the finished work of the several kinds of work called for. Only a single unit price shall be given and it shall apply for either MORE or LESS work than that shown on the drawings and called for in the specifications or included in the Base Bid. In the event of more or less units than so indicated or included, change orders may be issued for the increased or decreased amount.

PAYMENTS: By law, payments may not be started until thirty (30) days after the Contractor has commenced work, and thereafter, partial payments shall be made in accordance with the provisions of Section 34.057 RSMo., and in accordance with both Sections 34.057 RSMo. and 8.260 RSMo. for contracts in excess of \$100,000.00.

ARTICLE 5. PREVAILING WAGE RATE

Contractor agrees to fully comply with Sections 290.210-290.340 RSMo., and all rules and regulations established by the Department of Labor concerning the payment of the prevailing wage rate. Contractor further agrees to ensure that all sub-contractors similarly comply with the Missouri prevailing wage requirements.

It is further understood and agreed by and between the parties that not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work in the locality in which the work is performed, both as determined by the Department of Labor and Industrial Relations or as determined by the Court on appeal, shall be paid to all workers employed by or on behalf of the Contractor or any sub-contractor, exclusive of maintenance work. Only such workers as are directly employed by the Contractor or sub-contractors in actual construction work on the site shall be deemed to be employed.

When the hauling of materials or equipment includes some phase of the construction other than the mere transportation to the site of the construction, workers engaged in this dual capacity shall be deemed employed directly on the project and subject to the prevailing wage.

ARTICLE 6. CONTRACTOR'S PERSONNEL

The contractor understands and agrees that by signing the contract, they certify the following:

The contractor shall only utilize personnel authorized to work in the United States in accordance with applicable federal and state laws. This includes but is not limited to the Illegal Immigration Reform and Immigration Responsibility Act (IIRIRA) and INA Section 274A.

If the contractor is found to be in violation of this requirement or the applicable state, federal and local laws and regulations, and if the State of Missouri has reasonable cause to believe that the contractor has knowingly employed individuals who are not eligible to work in the United States, the Contractor shall be deemed in breach of contract and the state may terminate the contract without penalty or recourse, suspend or debar the business from doing business with the State of Missouri, and withhold up to twenty-five percent of the total amount due to the business upon termination of the contract as provided by Section 285.535 RSMo.

The Contractor agrees to fully cooperate with any audit or investigation from federal, state or local law enforcement agencies.

HEALTH AND SAFETY OF EMPLOYEES – Contractor shall ensure full compliance with Section 292.675 RSMo. concerning certain safety training requirements for all employees directly engaged in construction as defined by Section 292.675 RSMo. Specifically, Section 292.675 provides that any person signing a contract to work on the construction of public works for any public body shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for their on-site employees which includes a course in construction safety and health approved by OSHA or a similar program approved by the department which is at least as stringent as an approved OSHA program. All employees are required to complete the program within sixty days of beginning work on such construction project.

Any employee found on a work site subject to this section without documentation of the successful completion of the course required under subsection 2 of Section 292.675 shall be afforded twenty days to produce such documentation before being subject to removal from the project.

Contractor and any subcontractor shall require all on-site employees to complete the ten-hour training program required by Section 292.675 Missouri Revised Statutes, or such employees must hold documentation of prior completion of the program. The contractor shall forfeit as a penalty to the public body on whose behalf the contract is made or awarded, two thousand five hundred dollars plus one hundred dollars for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training. The penalty shall not begin to accrue until the time period in subsections 2 and 3 of Section 292.675 have elapsed.

ARTICLE 7. CERTIFICATION OF COMPLIANCE WITH STATE AND FEDERAL LAW

By entering this contract, Contractor certifies that Contractor is in compliance with all applicable state and federal laws, regulations and ordinances. Contractor further certifies:

That all vendors or vendor affiliates are in compliance with Section 34.040.6 RSMo. concerning payment and collection of sales/use taxes.

If applicable, that Contractor and all subcontractors and suppliers are in compliance with the provisions of Section 285.230-240 concerning the bonding and filing requirements for transient employers.

That Contractor and all subcontractors and suppliers are enrolled in and will continue to participate in a federal work authorization program in accordance with Chapter 285 RSMo for the duration of this contract.

That Contractor and all subcontractors and suppliers are compliant with the provisions of Chapter 290 RSMo regarding wage subsidies, bid supplements or rebates.

ARTICLE 8. CONTRACT DOCUMENTS

Contract documents shall consist of the following component parts:

1. Advertisement for Bids
2. Instructions to Bidders
3. The Contract
4. General Conditions
5. Special Conditions
6. The Drawings
7. The Detailed Specifications/Special Requirements
8. Contractor's Proposal as Accepted by the Owner
9. Prevailing Wage Determination
10. Affidavit - Compliance with Prevailing Wage Law
11. Affidavit of Work Authorization

IN WITNESS WHEREOF, the above bounded parties have executed the within instruments on the _____ day of _____, 20_____ (MDC will insert date)

For Corporation:

(Corporate Officer Signature)

(Corporate Officer Title)

I, _____, certify that I am Secretary of the corporation above named, that _____, who signed said contract on behalf of the corporation was then _____ of said corporation; that said Contract was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

(Corporate Secretary Signature)

(seal)

For Limited Liability Company (LLC):

(Managing Member/Member Signature)

(Title)

(seal)

For Partnership:

(Partner Signature)

(Title)

For Individual(s):

(Individual Signature)

(Title)

(Individual Signature)

(Title)

Recommended Approval:

Design and Development Division Chief
Missouri Department of Conservation

Approved As To Form Only:

General Counsel

Approved by:

Director
Missouri Department of Conservation

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006100 - PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, THAT we _____
as Principal, and _____
as Surety, are held and firmly bound unto the MISSOURI DEPARTMENT OF CONSERVATION, in the sum of
_____ Dollars (\$ _____), for payment whereof the Principal
and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by
these presents.

WHEREAS, the Principal has, by means of a written agreement dated the ____ day of _____,
20____, entered into a contract with the Missouri Department of Conservation for
SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT, 56-01-71, AND
STORAGE BUILDING IMPROVEMENTS, 56-01-64
(Insert Job Title & Job Number)

NOW, THEREFORE, if the Principal shall faithfully perform and fulfill all the undertakings, covenants,
terms, conditions and agreements of said contract during the original term of said contract and any extensions
thereof that may be granted by the Missouri Department of Conservation, with or without notice to the Surety and
during the life of any guaranty required under the contract; and shall also faithfully perform and fulfill all
undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said
contract that may hereafter be made with or without notice to the Surety; and shall also promptly make payment
for materials incorporated, consumed or used in connection with the work set forth in the contract referred to
above, and all insurance premiums, both compensation and all other kinds of insurance, on said work, and for all
labor performed on such work, whether by subcontractor or otherwise, at not less than the prevailing hourly rate
of wages for work of a similar character (exclusive of maintenance work) in the locality in which the work is
performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work (exclusive of
maintenance work) in the locality in which the work is performed both as determined by the Department of Labor
and Industrial Relations or determined by the Court on appeal, as provided for in said contract and in any and all
duly authorized modifications of said contract that may be hereafter made, with or without notice to the Surety,
then, this obligation shall be void and of no affect, but it is expressly understood that if the Principal should make
default in or should fail to strictly, faithfully and efficiently do, perform and comply with any or more of the
covenants, agreements, stipulations, conditions, requirements or undertakings, as specified in or by the terms of
said contract, and with the time therein named, then this obligation shall be valid and binding upon each of the
parties hereto and this bond shall remain in full force and effect; and the same may be sued on at the instance of
any material man, laborer, mechanic, subcontractor, individual, or otherwise to whom such payment is due, in the
name of the Missouri Department of Conservation, to the use of any such person.

AND, IT IS FURTHER specifically provided that any modifications which may hereinafter be made in the terms of the contract or in the work to be done under it or the giving by the Owner of any extension of the time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety, or either or any of them, their heirs, executors, administrators and successors, from their liability hereunder, notice to the Surety of any such extension, modifications or forbearance being hereby waived.

IN WITNESS WHEREOF, the above bounden parties have executed the within instrument this

_____ day of _____ 20_____.

AS APPLICABLE:

- A. An Individual(s) _____
(Signature) _____ Typed or Printed Name of Individual _____

(Signature) _____ Typed or Printed Name of Individual _____
- B. A Partnership _____
(Signature) Partner _____ Typed or Printed Name of Partner _____

(Signature) Partner _____ Typed or Printed Name of Partner _____
- C. LLC _____
(Firm Name) _____
(seal) _____
(Signature) Managing Member/Member _____ Typed or Printed Name of Managing Member/Member _____
- D. Corporation _____
(Firm Name) _____
(seal) _____
(Signature) President _____ Typed or Printed Name of President _____
- E. Surety _____
(Surety) _____ (Attorney-in-Fact) Typed or Printed Name _____

Surety Contact Printed or Typed Name _____ (Address of Attorney-in-Fact) _____

Address of Surety _____ (Telephone Number of Attorney-in-Fact) _____

Telephone Number of Surety _____ (seal) _____ (Signature) Attorney-in-Fact _____

Email Address for Surety Contact _____

NOTE: Surety shall attach Power of Attorney

MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006200 - AFFIDAVIT COMPLIANCE WITH PREVAILING WAGE LAW

I, _____, upon being duly sworn upon my oath state that: (1) I
(Name)
am the _____ of _____; (2) all
(Title) (Name of Company)
requirements of §§ 290.210 to 290.340, RSMo, pertaining to the payment of wages to workers employed on
public works projects have been fully satisfied with regard to this company's work on
SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND
STORAGE BUILDING IMPROVEMENTS;
(Name of Project)
(3) I have reviewed and am familiar with the prevailing wage rules in 8 CSR 30-3.010 to 8 CSR 30-3.060; (4)
based upon my knowledge of these rules, including the occupational titles set out in 8 CSR 30-3.060, I have
completed full and accurate records clearly indicating (a) the names, occupations, and crafts of every work
employed by this company in connection with this project together with an accurate record of the number of hours
worked by each worker and the actual wages paid for each class or type of work performed, (b) the payroll
deductions that have been made for each worker, and (c) the amounts paid to provide fringe benefits, if any, for
each worker; (5) the amounts paid to provide fringe benefits, if any, were irrevocably paid to a trustee or to a third
party pursuant to a fund, plan, or program on behalf of the workers; (6) these payroll records are kept and have
been provided for inspection to the authorized representative of the contracting public body and will be available,
as often as may be necessary, to such body and the Missouri Department of Labor and Industrial Relations; (7)
such records shall not be destroyed or removed from the state for one year following the completion of this
company's work on this project; and (8) there has been no exception to the full and complete compliance with the
provisions and requirements of Annual Wage Order No. 23 Section 110 issued by the Missouri Division
of Labor Standards and applicable to this project located in Taney County, Missouri, and completed on the
_____ day of _____.

The matters stated herein are true to the best of my information, knowledge, and belief. I acknowledge
that the falsification of any information set out above may subject me to criminal prosecution pursuant to §§
290.340, 570.090, 575.040, 575.050, or 575.060, RSMo.

Signature

Subscribed and sworn to me this _____ day of _____,
My commission expires _____.

(seal)
Notary Public

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006300 - AFFIDAVIT FOR AFFIRMATIVE ACTION

(State of Missouri)

(County of _____)

_____ first being duly sworn on his/her oath states: that he/she is the (sole proprietor, partner, member or officer) of _____ a (sole proprietorship, partnership, LLC, corporation), and as such (sole proprietor, partner, member or officer) is duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, LLC, corporation); that under the contract known as " SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS " Project No. 56-01-71 and 56-01-64 less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in Article 6 of the General Conditions of the State of Missouri have been met.

Contractor's Signature

Title

Subscribed and sworn to before me this _____ day of _____, 20_____.

My Commission expires _____, 20_____.

Notary Public

(seal)

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006310 – AFFIDAVIT FOR FINAL PAYMENT

TO ALL WHOM IT MAY CONCERN:

KNOW ALL MEN BY THESE PRESENTS, THAT WHEREAS, the undersigned

Full Legal Company Name	Address	City	State
hereinafter referred to as Contractor, and the Missouri Department of Conservation, hereinafter referred to as Department, have heretofore entered into a certain written contract dated the ____ day of _____, 20____, covering work to be performed and material to be furnished for <u>SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS</u> (Project Title)			

WHEREAS, Contractor has performed work and furnished materials provided for, under said contract up to and including the date hereof, and upon supplying proper waiver of liens is entitled to payment from the Department for the sum of \$ _____,

_____ DOLLARS, balance of said contract.
(written amount)

NOW, THEREFORE, in order to induce the Department to make payment of said sum, and if said sum represents the balance due under said contract, to induce the acceptance of said work and materials by the Department, Contractor hereby represents that all work performed and materials furnished under said contract up to and including the date hereof, including work and materials, if any, performed or furnished by subcontractors and material men, have been paid in full, and Contractor hereby waives any and all liens, rights of liens, and claims on or against the premises at the address above given, or on any and all structures and buildings located thereon, arising under any law of the State wherein said premises are situated, and hereby releases and agrees to save harmless the Department from and against any and all claims for and on account of work performed, or materials furnished by or for Contractor under said contract or otherwise Contractor represents that all Sales and Use taxes, if any, applicable to any material furnished by or for Contractor, have been paid in full.

Contractor's Signature

Contractor's Title

Personally appeared before me, a Notary Public, within and for the County of _____,
signed the foregoing Affidavit for the purposes therein stated.

Subscribed and sworn to before me this _____ day of _____, 20____.

(Signature of Official Taking Acknowledgment)

My Commission Expires _____

(seal)

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006350 - AFFIDAVIT OF WORK AUTHORIZATION

STATE OF _____) COUNTY OF _____)

On this _____ day of _____, 20_____, before me appeared _____, personally known to me or provided to me on the basis of satisfactory evidence to be a person whose name is subscribed to this affidavit, who being by me duly sworn, deposed as follows:

My name is _____, and I am of sound mind, capable of making this affidavit, and personally certify the facts herein stated, as required by Section 285.530, RSMo, to enter into any contract agreement with the state to perform any job, task, employment, labor, personal services, or any other activity for which compensation is provided, expected, or due, including but not limited to all activities conducted by business entities:

I am the _____ of _____, and I am duly authorized, directed, and/or empowered to act officially and properly on behalf of this business entity.

I hereby affirm and warrant that the aforementioned business entity is enrolled in a federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, and the aforementioned business entity shall participate in said program with respect to all employees working in connection with the contracted services related to

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS, 56-01-71 and 56-01-64

Name & Project Number

with the Missouri Department of Conservation. I have attached document to this affidavit to evidence enrollment/participation by the aforementioned business entity in a federal work authorization program, as required by Section 285.530, RSMo.

In addition, I hereby affirm and warrant that the aforementioned business entity does not and shall not knowingly employ, in connection to work under the within state contract agreement with Missouri Department of Conservation, an alien who does not have the legal right to authorization under federal law to work in the United States, as defined in 8 U.S.C. § 1324a(h)(3).

I am aware and recognize that, unless certain contract and affidavit conditions are satisfied pursuant to Section 285.530, RSMo, the aforementioned business entity may be held liable under Section 285.525 through 285.559, RSMo, for subcontractors that knowingly employ or continue to employ any unauthorized alien to work within the state of Missouri.

I acknowledge that I am signing this affidavit as a free act and deed of the aforementioned business entity and not under duress.

Contractor's Signature

Subscribed and sworn to before me this _____ day of _____, 20_____.

Notary Public

My commission expires: _____

(seal)

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006410 - FINAL RECEIPT OF PAYMENT AND RELEASE

KNOW ALL MEN BY THESE PRESENTS THAT: _____

Subcontractor or Material Supplier

hereinafter called "Subcontractor" or "Material Supplier" who heretofore entered into a subcontract with _____

(Contractor Name)

hereinafter called "Contractor", for the performance of work and/or the furnishing of material for the construction of a project entitled:

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS, 56-01-71 and 56-01-64

(Project Title and Project Number)

at 483 Hatchery Rd, Branson, MO 65616

(Address of Project)

for the Missouri Department of Conservation, (Owner) which said subcontract is by this reference incorporated herein, in consideration of such final payment by Contractor, DOES HEREBY:

1. ACKNOWLEDGE that the Subcontractor, or material supplier has been **PAID IN FULL** all sums due for everything done by the Subcontractor, or done by its subcontractors, material vendors, equipment and fixture suppliers, agents and employees, or otherwise in the performance of the work called for by the aforesaid contract and all modifications or extras or additions thereto, for the construction of said project or otherwise.
2. RELEASE and fully, finally and forever discharge Contractor and the Owner of and from any and all suits and actions, claims and demands of whatsoever kind or character arising out of or in any manner related to anything and everything done or omitted by Subcontractor or material suppliers, its subcontractors, material vendors, equipment and fixture suppliers, agents and employees, in the performance of or connected with its/their performance of said work, or otherwise.
3. REPRESENT that all of their employees, subcontractors, material vendors, equipment and fixture suppliers and everyone else has been paid in full all sums due them, or any of them, in connection with performance of said work, or anything done or omitted by them or any of them in connection with the construction of said improvements, or otherwise.

DATED this _____ day of _____, 20____.

(Name of Subcontractor or Material Supplier)

(Signature)

(Typed or printed name)

(Title)

Subscribed and sworn to before me this _____ day of _____, 20____

Notary Public

My commission expires: _____

(seal)

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006420 - MBE/WBE PROGRESS REPORT

(For Projects \$100,000 or more) (SUBMIT WITH MONTHLY WORK & MATERIAL ESTIMATE)

56-01-71 & 56-01-64

DATE:

PROJECT NUMBER:

PAY ESTIMATE #

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE
BUILDING IMPROVEMENTS

PROJECT TITLE:

483 Hatchery Rd, Branson, MO 65616

LOCATION:

GENERAL CONTRACTOR:

TOTAL CONTRACT AMOUNT OF THIS PROJECT:

THE PERCENTAGE AND DOLLAR AMOUNT OF THIS PROJECT THAT ARE TO BE MBE/WBE AS
INDICATED IN THE AWARDED CONTRACT: _____ %, \$ _____

M = MBE W = WBE	ITEM OF WORK	ORIGINAL AMOUNT OF SUBCONTRACT	\$ AMOUNT & % COMPLETE (PAID TO DATE)	SUB/SUPPLIER NAME ADDRESS/PHONE NAME TO CONTACT

Submitted by: _____ Date: _____

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MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006450 - CERTIFIED PAYROLL RECORDS

1.1 GENERAL

- A. The Contractor shall submit certified copies of their weekly payroll records to the Owner using the enclosed Payroll Record or Missouri Department of Labor and Industrial Relations Contractor Payroll Records Form LS-57. The Owner will assure compliance with the provisions of the prevailing wage law. The examination of the payroll records will be done on a monthly basis as payments are requested by the Contractor, in accordance with 290.290 RSMo and CSR 30-3.010.
- 1. The following pages of this document include:
 - a. Instruction Sheet for Certified Payroll Records
 - b. Contractor Payroll Record
- B. An electronic copy of the Contractor Payroll Record is available at request through the Owner, or available at Missouri Department of Labor and Industrial Relations, Division of Labor Standards, Prevailing Wage Section website: www.labor.mo.gov/DLS/Forms/LS-57-AI.pdf.

INSTRUCTION SHEET FOR CERTIFIED PAYROLL RECORDS

Contractor or Subcontractor: Fill in your firm's full legal company name and check appropriate box.

Address: Fill in your firm's address and noted information.

Name of Public Body: MISSOURI DEPARTMENT OF CONSERVATION

Address: 2901 W. TRUMAN BLVD.
JEFFERSON CITY, MO 65109
(573) 751-4115

Payroll No.: Begin with payroll No. 1.
Payroll reports must be submitted each week. If work was not performed in specified week, note "No Work". Payroll numbers must be consistent from beginning until completion of project. Note "Final" on the last payroll report for project.

For Week Ending: List the workweek ending date.

AWO: Indicate Annual Wage Order Number.

Project/Location: SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE BUILDING IMPROVEMENTS

Project or Contract No.: 56-01-71 and 56-01-64

- Column 1** **Name and Address of Employee:** List workers that worked on project for that week. Enter each worker's full name and address on weekly payroll. **Both the name and address must be listed.**
- Column 2** **Occupational Title:** List the occupational title of each worker. A worker may perform work under different occupational titles. The employer must keep accurate records showing the breakdown of hours worked for each occupational title. For a list of occupational titles, visit <http://www.sos.mo.gov/adrules/csr/current/8csr/8c30-3.pdf>.
- Column 3** **Day and Date:** List day of week in the top row (Su - M - Tu - W - Th - F - Sa), begin with the first day of the pay period. List calendar date in the bottom row (1, 2, 3, 4, 5, 6, 7 ...).
- Hours worked:** Record number of hours worked per day.
 Straight Time (ST), Overtime (OT), Double Time (DT), if applicable.
- Column 4** **Total Hours:** Total hours worked for the listed week on this project.
- Column 5** **Hourly Rate of Pay:** List the actual hourly rate paid for straight time worked (include regular hourly rate plus hourly rate of any additional amount paid in cash in lieu of providing fringe benefits). When overtime is worked, show the overtime hourly rate paid (include the regular overtime hourly rate plus hourly rate of any amount paid in cash in lieu of fringe benefits) in the "Overtime" box for each worker.

- Column 6** **Gross Amount Earned:** TOP CORNER – Project gross amount earned this pay period, on this project for the listed week. LOWER CORNER – Week total gross amount earned during week for work on all projects. If part of a worker's weekly wage was earned on projects other than the project described on given payroll, then the gross amount earned is gross earned for the week on all projects, (example: "\$163/\$420" would reflect a worker who earned \$163 on a public works construction project and a total of \$420 from all work performed for the listed week, including the public works project).
- Column 7** **Deductions:** Complete all required deductions. List any additional deductions in the "Other" column. Add all deductions, and place total in the "Total Deductions" column. On page 2 of the form, describe the deduction(s) contained in the "Other" columns in the space provided. If an individual worked on other jobs in addition to this project, show actual deductions from his/her weekly gross wage.
- Column 8** **Net Wages Paid for Week:** Net wages paid for the listed week on all projects. This is the take-home amount for given week.

Page Two (Back of Form)

FRINGE BENEFITS – Identify the type of fringe benefits provided and list the amounts actually paid for each fringe benefit to each employee for the pay period (if fringe benefit amounts paid are the same for all employees, you may list the amount of each identical fringe payment only once in the appropriate column; if the fringe benefit amounts vary by employee, list each employee's name and set out the amounts paid on behalf of each employee for each fringe benefit).

Any contractor making payment to approved plans, funds, or programs in amounts less than the wage determination requires (or not making such fringe payments at all), is obliged to pay the deficiency directly to the covered worker as cash in lieu of fringe benefits. The contractor must pay an amount not less than the prevailing wage rate applicable to each worker (both the cash and fringe benefits portions) for all hours worked. Any combination of wages paid and fringe benefits provided, however, is acceptable.

Required Statement: An authorized agent of the contractor or subcontractor must complete and sign the "statement of compliance." The entry of any false information in this form will result in the agent and the contractor or subcontractor being subject to criminal prosecution and penalties under §§ 290.340, 575.050, 575.060, and 575.080, RSMo.



MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
CONTRACTOR PAYROLL RECORDS
(See Sections 290.210 to 290.340, RSMo and 8 CSR 30-3.010 to 8 CSR 30-3.060)

Name of <input checked="" type="checkbox"/> Contractor <input type="checkbox"/> Subcontractor				Address of Contractor or Subcontractor: City: _____ State: _____ ZIP: _____ Phone Number: () - _____													
Name of Public Body Missouri Department of Conservation				Address of Public Body: 2901 W. Truman Blvd. City: Jefferson City State: MO ZIP: 65109 Phone Number: (573) 751 - 4115													
Payroll No.	For Week Ending / /	AWO Taney County	Project and Location Shepherd of the Hills Fish Hatchery Conservation Center Replacement and Storage Building Improvements										Project or Contract No. 56-01-73 & 56-01-64				
1. Name and Address of Employee	2. Occupational Title ***	3. Day and Date							4. Total Hours	5. Hourly Rate + Cash Fringe	6. Gross Amt Project Week	7. Deductions					8. Net Wages Paid for Week
		Day										FICA and Medicare	Federal and State Withhold- ing Tax	Other A	Other B	Total Deduc- tions	
		Date															
		DT									/						
		OT									/						
		ST									/						
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FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

In addition to the basic rates paid to each laborer or mechanic on the payroll, payments have been or will be made to appropriate programs for the benefit of these employees as shown in the following chart below. If fringe benefit amounts paid are the same for all employees, you may list the amount of each such identical fringe payment only once in the appropriate column; if the fringe benefit amounts vary by employee, list each employee's name and set out the amounts paid on behalf of each employee for each fringe benefit.

Employee Name	Health and Welfare (\$/hr)	Pension (\$/hr)	Vacation (\$/hr)	Holiday (\$/hr)	Apprentice Training (\$/hr)	Other C (\$/hr)	Other D (\$/hr)	Total (\$/hr)	If "Other/Deduction" or Fringes, please explain. (Indicate Other A, B, C or D)	Identify by name, the plan, fund, or programs to which fringe benefits are paid. (Indicate H&W, Pension, etc.)

Date: _____

I, _____ (Name of Signatory Party), _____ (Title) do hereby state:

(1) That I pay or supervise the payment of the persons employed by _____ (Contractor or Subcontractor) on the Shepherd of the Hills Conservation Ctr. & Storage Bldg. (Building or Work); that during the payroll period commencing seven (7) days prior to the week ending date of _____ all persons employed on said project have been paid the full weekly wages stated above, that no rebates have been or will be made either directly or indirectly to or on behalf of _____ (Contractor or Subcontractor), from the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than legally permissible deductions, that full and accurate records clearly indicating the names, occupations, and crafts of every worker employed by them in connection with the public work together with an accurate record of the number of hours worked by each worker and the actual wages paid for each class or type of work performed and deduction made for each worker have been prepared, that these payroll records are kept and have been provided for inspection to the authorized representative of the contracting public body and will be available as often as may be necessary and such records shall not be destroyed or removed from the state for the period of one year following the completion of the public work in connection with which the records are made.

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage order incorporated into the contract; that the occupational title set forth herein for each laborer or mechanic conform with the work performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a state apprenticeship agency recognized by the Office of Apprenticeship (OA), U.S. Department of Labor (USDOL), or if no such recognized agency exists in a state, are registered with the OA, USDOL.

Name and Title	Signature
The falsification of any of the above statements may subject the contractor or subcontractor to criminal prosecution. See Sections 290.340, 570.090, 575.050, and 575.060, RSMo.	

Missouri Department of Labor and Industrial Relations is an equal opportunity employer/program.

MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006500 – MATERIAL SUPPLIER - PRODUCT SUBSTITUTION REQUEST

☐

Substitution Following Award

☐

Additional Material Supplier Following Award

(Maximum of 30 days from Notice to Proceed as per Document 007000-General Conditions, Article 16)

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE
BUILDING IMPROVEMENTS, 56-01-71 and 56-01-64
PROJECT TITLE, PROJECT NUMBER:

ARCHITECT/ENGINEER:

BIDDER/CONTRACTOR REQUESTING SUBSTITUTION:

Bidder/contractor hereby requests acceptance of the following product or systems as a substitution in accord with provisions of the contract:

SPECIFIED PRODUCT OR SYSTEM:

SPECIFICATION DOCUMENT NUMBER:

SUPPORTING DATA:

☐

Product data for proposed substitution is attached. (include description of product, standards, performance and test data)

☐

Sample

☐

Sample will be sent if requested.

QUALITY COMPARISON

	SPECIFIED PRODUCT	SUBSTITUTION REQUEST
NAME BRAND:		
CATALOG NUMBER:		
MANUFACTURER:		
MATERIAL SUPPLIER:		

PREVIOUS INSTALLATIONS

PROJECT NAME:	PROJECT DOLLAR VALUE:
PROJECT LOCATION:	DATE INSTALLED:
OWNER/CONTACT:	CONTACT PHONE NUMBER:

SIGNIFICANT VARIATIONS

REASON FOR SUBSTITUTION:

PROPOSED SUBSTITUTION AFFECTS OTHER PARTS OF WORK:

YES ☐

NO ☐

IF YES, EXPLAIN

SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A&E WORK:

YES ☐

NO ☐

BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:

I/we have investigated the proposed substitution. I/we believe that it is equal or superior in all respects to specified product, except as stated above; that it will provide the same warranty as specified product; that it will provide the same maintenance service and source replacement parts; that I/we have included complete implications of the substitution; that I/we will pay redesign and other costs caused by the substitution which subsequently become apparent; and that I/we will pay associated costs, including changes to the building design, project management, detailing, and actual construction costs to modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning resulting from the substitution. The proposed substitution will have no adverse effect on mechanical, plumbing, fire sprinkler, electrical, or other trades, nor will it delay schedule.

BIDDER/CONTRACTOR:

DATE:

REVIEW AND ACTION

☐ Resubmit product substitution request with the following additional information: _____

☐ Material supplier - product substitution request is accepted

☐ Material supplier - product substitute request is accepted with the following comments: _____

☐ Material supplier - product substitution request is not accepted

ARCHITECT/ENGINEER

DATE

MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT DIVISION

DOCUMENT 006510 – SUBCONTRACTOR SUBSTITUTION - ADDITIONAL REQUEST

☐ Subcontractor Substitution Following Award ☐ Additional Subcontractor Following Award

SHEPHERD OF THE HILLS FISH HATCHERY CONSERVATION CENTER REPLACEMENT AND STORAGE
BUILDING IMPROVEMENTS, 56-01-71 and 56-01-64
PROJECT TITLE, PROJECT NUMBER

ARCHITECT/ENGINEER: _____

BIDDER/CONTRACTOR REQUESTING SUBSTITUTION - ADDITIONAL SUBCONTRACTOR: _____

Bidder/contractor hereby requests acceptance of the following subcontractor as a substitution - additional in accord with provisions of the contract:

FULL LEGAL COMPANY NAME OF REQUESTED SUBSTITUTION - ADDITIONAL SUBCONTRACTOR _____

ADDRESS: _____

CITY/STATE: _____ TELEPHONE: _____

Description of Work: _____

Is proposed Subcontractor a: ☐ MBE ☐ WBE ☐ Neither MBE or WBE

PREVIOUS/CURRENT PROJECTS

PROJECT NAME:	PROJECT DOLLAR VALUE:
PROJECT LOCATION:	DATE OF WORK:
OWNER/CONTACT:	CONTACT PHONE NUMBER:
PROJECT NAME:	PROJECT DOLLAR VALUE:
PROJECT LOCATION:	DATE OF WORK:
OWNER/CONTACT:	CONTACT PHONE NUMBER:
PROJECT NAME:	PROJECT DOLLAR VALUE:
PROJECT LOCATION:	DATE OF WORK:
OWNER/CONTACT:	CONTACT PHONE NUMBER:

REASON FOR SUBSTITUTION - ADDITIONAL:

BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION - ADDITIONAL TO CONTRACT REQUIREMENT:

I/we have investigated the proposed substitution - additional subcontractor. I/we believe that the proposed subcontractor's work is equal or superior in all respects to our originally proposed subcontractor.

BIDDER/CONTRACTOR:

DATE:

REVIEW AND ACTION

☐ Resubmit subcontractor substitution - additional request with the following additional information: _____

☐ Subcontractor substitution request is accepted

☐ Subcontractor substitution request is accepted with the following comments: _____

☐ Subcontractor substitution request is not accepted

☐ Additional subcontractor request is accepted

☐ Additional subcontractor request is accepted with the following comments: _____

☐ Additional subcontractor request is not accepted

ARCHITECT/ENGINEER

DATE

☐ Subcontractor company name verified with Missouri Secretary of State

DOCUMENT 007000 - GENERAL CONDITIONS

1.1 GENERAL

- A. These General Conditions apply to each document/section of these specifications and must be carefully read by the Contractor and subcontractor, as all are subject to the provisions contained herein.
- B. The General Conditions are intended to define the relationship of the Owner, Contractor, and all subcontractors thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

ARTICLE 1- DEFINITIONS

- A. As used in these contract documents, the following terms shall have the meanings and refer to the parties designated in these definitions.
 - 1. "OWNER": Whenever the term "Owner" is used, it shall mean the Missouri Department of Conservation or its designated representative.
 - 2. "DIRECTOR": Whenever the term "Director" is used, it shall mean the Director of the Missouri Department of Conservation.
 - 3. OWNER'S "PROJECT MANAGER": Whenever the term "Project Manager" is used, it shall mean the Owner's Project Engineer or Project Architect who is the designated employee representative responsible for overall project management.
 - 4. OWNER'S "CONTRACT SUPERVISOR": Whenever the term "Contract Supervisor" is used, it shall mean the Owner's designated employee representative at the work site.
 - 5. "CONTRACTOR": Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
 - 6. "SUBSTANTIALLY COMPLETE": The stage in the progress of the work when the work or designated portion thereof is sufficiently complete in accordance with the contract documents so the Owner may occupy or utilize the work for the intended use.
 - 7. "SUBCONTRACTOR": Party or parties who contract under, or for the performance of part or all of the contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
 - 8. "WORK": Labor, material, supplies, plant and equipment required to perform and complete the service agreed to by the Contractor in safe, expeditious, orderly and workmanlike manner so that the project shall be complete and finished in the best manner known to each respective trade.
 - 9. "CONTRACT DOCUMENTS": The "Contract Documents" shall consist of the executed contract, the General Conditions, the Advertisement for Bids, the Instructions to Bidders, the Proposal, the Prevailing Wage Determination, the Specifications and Drawings, including all modifications as set forth in Addenda or Change Orders to any of the above, the required Certificates of Insurance and Performance/Payment Bond, and Notice to Proceed.
 - 10. "CONTRACT TIME": The number of working days shown in the proposal as the time allowed for the completion of the work contemplated in the contract.
 - 11. "WORKING DAY": All calendar days except Saturdays, Sundays and the following holidays: New Year's Day, Martin Luther King Jr., Day, Lincoln's Birthday, President's Day, Truman Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day, where in the judgment of the Owner, soil and weather conditions are such as would permit any then major operation of the project.
 - 12. CONTRACTOR'S "SUPERINTENDENT": Whenever the term "Superintendent" is used, it shall mean the Contractor's designated employee representative at the work site at all times during the progress of any and all work. The Contractor shall have only one (1) named superintendent at a time whenever work is in progress.

ARTICLE 2 - DRAWINGS AND SPECIFICATIONS.

- A. Drawings are intended to show general arrangements, design and extent of work and are partly diagrammatic. As such, they are not intended to be scaled for roughing-in measurements or to serve as shop drawings.
- B. Specifications are separated into titled divisions for convenience of reference only and to facilitate letting of contracts and subcontracts. The Contractor is responsible for establishing the scope of work for subcontractors, which may cross titled divisions. The Owner will establish limits and jurisdiction of subcontracts.
- C. Figured dimensions take precedence over scaled measurements and details take precedence over smaller scale general drawings. In the event of conflict between any of the documents contained within the contract, the documents shall take precedence and be controlling in the following sequence: addenda, general conditions, specifications, drawings, bid form and instructions to bidders.
- D. In case of discrepancy between drawings and specifications, specifications shall govern. Should discrepancies in architectural drawings, structural drawings and mechanical drawings occur, architectural drawings shall govern and, in case of conflict between structural and mechanical drawings, structural drawings shall govern.
- E. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any incidental work which is obviously necessary to complete the project within the limits established by the drawings and specifications, although not shown on or described therein, shall be performed by the Contractor as a part of the contract.
- F. The Owner cannot and does not guarantee the accuracy of data concerning lot size, ground elevations, present obstructions on or near the site, locations and depth of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions..
- G. Upon encountering conditions differing materially from those indicated in the contract documents and/or ordinarily encountered and generally recognized as inherent to the work provided for in this contract, the Contractor shall promptly notify the Owner in writing before such conditions are disturbed. The Owner shall promptly investigate said conditions and, if the Owner finds that the conditions do materially differ and cause an increase or decrease in contract cost or time required for completion of any portion of the work, a change order will be initiated as outlined in Article 26 of these General Conditions.
- H. Only work included in the contract documents is authorized, and the Contractor shall do no work other than that described herein or in accordance with appropriately authorized and approved change orders.

ARTICLE 3 - RIGHTS AND RESPONSIBILITIES OF OWNER

- A. The Owner shall give all orders and directions contemplated under the contract relative to the execution of the work. The Owner shall determine the amount, quality, acceptability and fitness of kind of work and materials which are to be paid for under this contract. In the event any question shall arise between the parties hereto, relative to the contract or specifications, determination or decision of the Owner shall be a condition precedent to the right of the Contractor to receive any money or payment for work under the contract affected in any manner or to any extent by such question.
- B. The Owner may file written notice to the Contractor to dismiss forthwith their superintendent, any of the subcontractors, or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work, and contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.
- C. If Contractor or the subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall coordinating of the work, the Owner may take such appropriate action and issue such instructions as may be required to avoid unnecessary and unwarranted delay.
- D. If in the judgment of the Owner it becomes necessary at any time to accelerate work, the Contractor, when ordered by the Owner in writing, shall cease work at any point and transfer workers to such point or points and execute such portions of the work as may be required to enable others to hasten and properly engage and carry out their work, all as directed by the Owner, as may be required to complete the work within the contract time period.

ARTICLE 4 - INSPECTION OF THE WORK.

- A. The Owner and any authorized representative of the Owner shall at all times have access to the work whenever it is in preparation or progress, and Contractors shall provide proper facilities for such access and for inspection and supervision.
- B. During progress of work the Owner will be represented at the project by the Contract Supervisor, whose duty will be to see that the contract is properly fulfilled.
- C. The Contract Supervisor's inspections are for the purpose of assuring the Owner that the drawings and specifications are being properly executed. Although the Contract Supervisor is instructed to confer with the Contractor regarding interpretation of drawings and specifications, such assistance shall not relieve the Contractor of any responsibility for the work.
- D. All materials and workmanship used in the work shall be subject to the inspection of the Owner. Any work which is deemed defective by the Owner shall be removed, rebuilt or made good immediately upon notice of the defect. Any materials not approved by submittal or not meeting the specifications will be rejected. All rejected materials shall be immediately removed from the site of the work. The cost of such corrections shall be borne by Contractor. The Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work or rejected materials.
- E. The fact that the Owner has failed to observe faulty work, or work done which is not in accordance with the drawings and specifications, shall not relieve the Contractor from responsibility for correcting such work without additional compensation.
- F. The Owner shall have the right to direct the Contractor to uncover any completed work:
 - 1. If the Contractor fails to adequately notify the Owner that certain work performed is ready for inspection, as required by the Contract Documents, the Contractor shall upon written request uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.
 - 2. If the Owner directs work to be uncovered, which was not otherwise required to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet the requirements of the contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.
- G. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may by contract or otherwise have the defects remedied or rejected, materials removed from the site and charge the cost of the same against any monies which may be due the Contractor without prejudice to any other rights or remedies of the Owner on the premises.
- H. The Contractor must notify the Owner at least two working days before placing concrete or burying underground utilities, pipelines, etc., including placing soil or rock that may require moisture and density testing.

ARTICLE 5 - COMPLIANCE WITH LAWS, PERMITS, REGULATIONS AND INSPECTIONS.

- A. Since the Owner is the Missouri Department of Conservation, municipal or political subdivision ordinances, zoning ordinances, construction codes and other like ordinances are not applicable to construction on Owner's property, and Contractor will not be required to submit drawings and specifications to any municipal or political subdivision authority, obtain construction permits or any other licenses or permits from or submit to inspections by any municipality or political subdivision relating to the construction of this project. All permits or licenses required by municipality or political subdivision for operation on property not belonging to Owner shall be obtained by and paid for by Contractor. Each Contractor shall comply with all applicable laws, ordinances, rules and regulations.

ARTICLE 6 - NONDISCRIMINATION IN EMPLOYMENT.

- A. The Contractor and all subcontractors will comply with all state and federal employment, wage, disability, occupational safety, and anti-discrimination laws, rules, regulations, and guidelines. The Contractor and subcontractors will not discriminate against individuals based on race, color, religion, national origin, sex, disability, or age but may use restrictions which relate to bona fide occupational qualifications as allowed by applicable law. Specifically, the Contractor and subcontractors shall not discriminate:

1. Against recipients of service on the basis of race, color, religion, national origin, sex, disability or age.
2. Against any employee or applicant, for employment on the basis of race, color, religion, national origin, sex or otherwise qualified disability status.
3. Against any applicant for employment or employee on the basis of a disability as defined by the Americans with Disabilities Act.
4. Against any applicant for employment or employee on the basis of age, where such applicant or employee is between ages 40 and 70 and where such contractor employs at least 20 persons.
5. Against any applicant for employment or employee on the basis of that person's status as a disabled or Vietnam-era veteran.

The Contractor and subcontractors will take affirmative action to insure applicants for employment and employees are treated without regard to race, color, religion, national origin, sex, disability, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion and transfer; recruitment or recruitment advertising; and selection for training, including apprenticeship. The Contractor and Subcontractors will give written notice of their commitments under this clause to any labor union with which they have bargaining or other agreements.

- B. The Contractor and/or subcontractors shall develop, implement, maintain and submit in writing to the Owner an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed [by them] under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed Affidavit for Affirmative Action in the form as included in the contract specifications. For the purpose of this document, an "affirmative action program" means positive action to influence all employment practices (including, but not limited to, recruiting, hiring, promoting and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between age 40 and 70), disabled and Vietnam-era veteran status, and disability. Such "affirmative action program" shall include:
1. A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination;
 2. The identification of a person designated to handle affirmative action;
 3. The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion and discipline;
 4. The exclusion of discrimination from all collective bargaining agreements; and
 5. Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

In the enforcement of this non-discrimination clause, the Owner may use any reasonable procedures available, including, but not limited to: requests, reports, site visits and inspection of relevant documents of contractors and subcontractors.

- C. In the event of the Contractor's or a Subcontractor's noncompliance with any provisions of this Article of the contract, the Owner may cancel this contract in whole or in part or require the Contractor to terminate their contract with the subcontractor.

ARTICLE 7 - ANTI-KICKBACK.

- A. No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part hereof. No officer, employee, architect, attorney, engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this contract, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

ARTICLE 8 - PATENTS AND ROYALTIES.

- A. The Contractor shall hold and save the Owner and its officers, agents, servants and employees harmless from liability of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured, used or sold in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.
- B. If the Contractor uses any design, device or materials covered by letters or common law, patent, trademark/tradename or copyright, there shall be provisions for such use by suitable agreement with the owner or license holder of such patented, trademarked, or copyrighted design, device or material. It is mutually agreed and understood, without exception, that the contract prices shall include all royalties or costs arising from the use of such design, device or materials in any way involved in the work. The Contractor and/or the sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented, trademarked or copyrighted design, device or materials or any trademark, patent or copyright in connection with work agreed to be performed under this contract and shall indemnify the Owner for any cost, expense or damage it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.
- C. The Contractor and/or the sureties shall indemnify and save harmless the Owner, including payment of costs, attorney fees or other damages, incurred by Owner from any and all claims related to the use of any information, materials, or processes that are protected trade secrets and/or confidential materials protected by law or agreement.

ARTICLE 9 - STATUTORY PREFERENCE.

- A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the State of Missouri when they are found in marketable quantities in the State, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes 1994 and Cumulative Supplements.
- B. Furthermore, pursuant to Section 34.073 Missouri Revised Statutes 1994 and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the non-domiciliary's state as required by Section 34.076 RSMo.

ARTICLE 10 - COMMUNICATIONS.

- A. All notices, requests, instructions, approvals and claims to the Owner must be in writing and shall be delivered to the Owner unless otherwise specified by the Owner in writing. All papers required to be delivered to the Owner shall, unless otherwise specified by the Owner in writing be delivered to the Missouri Department of Conservation, Design and Development Division, 2901 West Truman Blvd., P.O. Box 180, Jefferson City, Missouri 65102-0180. Any such notice shall be deemed to have been given as of the time of actual receipt.
- B. Any notice to the Contractor from the Owner relative to any part of this contract shall be in writing and considered delivered and service thereof complete when said notice is posted by registered or certified mail to said Contractor at the last given address, or delivered in person to said Contractor or the authorized representative on the work.

ARTICLE 11 - DUTIES OF CONTRACTOR.

- A. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and insure completion thereof within the time specified. The Contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the Department of Labor and Industrial Relations of the State of Missouri and as set out in the contract specifications. A copy of the wage determination issued for the project and included as a part of the contract documents shall be posted in a prominent and easily accessible location at the site of construction. The Wage Rate notice shall remain posted during the full time that any workers shall be performing work included in this construction contract. The Contractor or any subcontractor found guilty

of one or more prevailing wage violations will be disqualified from doing business with the state in accordance with Section 290.330 Missouri Revised Statutes 1994 and Cumulative Supplements.

- B. The Contractor and subcontractor or subcontractors shall submit to the Owner, such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as may be requested concerning work performed or to be performed under the contract.
- C. The Contractor shall give access to, upon written request from the Owner, all time cards, material invoices, payrolls, profit and loss statements, and all other direct or indirect costs related to this work.
- D. The Contractor shall be responsible for laying out all the work and for any damage which may occur to work of any other contractor because of errors or inaccuracies, as well as be responsible for unloading and handling of all materials and equipment to be erected or placed by them, whether furnished by Contractor or others. Layout of mechanical and electrical work shall be coordinated with layouts of Contractor for general construction work. Unless otherwise directed by Owner, salvage materials, waste and scrap resulting from such work shall be promptly removed from the site by the responsible contractor.
- E. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property.
- F. Contractors shall prearrange time with the Owner in case it becomes necessary for the interruption of any service to make connections, alterations or relocations and shall fully cooperate with Owner in doing work so as to cause the least annoyance and interference with the continuous operation of the facility. Unless otherwise specified in these documents, all connections, alterations or relocations will be performed during normal working hours.
- G. Each Contractor shall coordinate all work so there shall be no prolonged interruption of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary which affect portions of this construction or building or any other building must be scheduled with the Owner to minimize or avoid any disruption of facility operations. In no case, unless previously approved in writing by the Owner shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor, responsible for the interruption, from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workmen responsible for the repair and restoration leave the job.
- H. Each Contractor shall be responsible for repair of their damage to property on or off the project occurring during construction of the project, and all such repairs shall be made to the satisfaction of the property owner.
- I. Contractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.
- J. Each Contractor shall be responsible for shoring required to protect the work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving any required notice to adjacent property owners and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.
- K. During the performance of work the Contractor shall be responsible for providing and maintaining with diligence warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment. Such warning and protective devices shall be removed only when approved by the Owner.
- L. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed or to be installed.
- M. The Contractor shall be responsible for care of all finished work and must protect same from damage or defacement until final acceptance by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner. Any claim for reimbursement shall be submitted in accordance with Article 26.
- N. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

1. In the event the Contractor encounters on the site material reasonably believed to be hazardous materials not otherwise identified in the contract documents, which has not been rendered harmless, the Contractor shall immediately stop work in the area affected and report the condition to the Owner in writing. The work in the affected area shall not thereafter be resumed except by written agreement of the Owner and Contractor if in fact the material is hazardous and has not been rendered harmless. The work in the affected area shall be resumed in the absence of hazardous materials, or when it has been rendered harmless, by written agreement of the Owner and Contractor, or in accordance with final determination by the Owner.
2. The Contractor shall not be required pursuant to Article 26 to perform, without the Contractor's consent, any work relating to hazardous materials.
3. The Contractor shall take reasonable precautions for the safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
 - a. Employees on the work site and other persons who may be affected thereby;
 - b. The work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or sub-subcontractors; and
 - c. Other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.
4. The Contractor shall give notices and comply with applicable State and Federal laws, ordinances, rules, regulations and lawful orders bearing on safety of persons or property or their protection from damage, injury or loss.
5. When use or storage of explosives or other hazardous materials or equipment or unusual methods are approved by the Owner for execution of the work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.
6. The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner.
7. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 26.
- O. The Contractor, at the Contractor's option, may employ worker or workers for watchman service at all times outside of regular working hours, and at such times during working hours when work is not in progress, from the time the work is started until the entire work is complete. This watchman service will in no way relieve the Contractor of the responsibility for replacing or making good any theft or damage.
- P. The Contractor shall give the Owner notice of any error or omission found in the plans and/or specifications and/or surveys and shall not perform any erroneous work until instructions are received from the Owner on how to proceed. If the Contractor knowingly constructs or performs erroneous work it shall be corrected at the Contractor's expense.
- Q. Before commencing work, Contractors shall confer with the Owner and ascertain full knowledge of all rules and regulations affecting the working conditions for the area. Rules and regulations in force at the area shall take precedence over rules and regulations that exist outside of the institution's jurisdiction. If the Contractor observes that the drawings and specifications are at variance therewith, they shall promptly notify the Owner in writing, and any necessary changes shall be adjusted as provided in the contract for changes in the work. If the Contractor performs any work to be contrary to such laws, ordinances, rules and regulations and without such notice, the Contractor shall bear all costs arising therefrom and save the Owner "harmless".
- R. Project signs will only be erected on major projects and only as specified. If no sign is specified, none shall be erected.
- S. Contractor must verify all measurements and all cumulative dimensions and accommodate installation of fixtures and equipment during all phases of construction. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.

- T. The Contractor shall provide at the proper time such material as is required for support of the work. If openings or chases are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed whether by the Contractor or Subcontractor whose duty it is to construct the same.
- U. All rubbish, debris and dirt resulting from the Contractor's work shall be cleaned up as required, and removed from the building/site. The premises shall at all times be kept in a clean, safe and workmanlike manner.
- V. The Contractor shall request in writing, a substantial completion inspection in accordance with Article 14. Prior to inspection, the Contractor shall remove manufacturer's advertising labels from windows, fixtures, equipment and shall leave the work "broom clean" or its equivalent, unless more exactly specified in the contract documents. Prior to receiving final payment, the Contractor shall complete all punchlist items, provide all close-out documentation, provide as-builts and manuals, and remove all rubbish, tools, scaffold, etc., from the site.
- W. If any work is required to be specially tested or approved, Contractor shall give the Owner timely notice of date for such inspection.

ARTICLE 12 - BOND.

- A. Contractor shall furnish a performance/payment bond in an amount at least equal to 100% of the contract price to guarantee faithful performance of the contract and to guarantee the payment of all persons performing labor on the project and furnishing materials in connection therewith under this contract as set forth in the standard form of performance/payment bond included in the contract documents. The surety on such bond shall be issued by a surety company authorized by the Missouri Department of Insurance to do business in the state of Missouri.
- B. All Performance/Payment Bonds furnished in response to this provision shall be provided by a bonding company with a rating of B+ or higher as established by A.M. Best Company, Inc. in their most recent publication. This requirement may only be waived upon written approval of the Division Chief.

ARTICLE 13 - COMMENCEMENT AND COMPLETION OF WORK.

- A. Before a "Notice to Proceed" will be issued the Contractor must submit the following properly executed instruments to the Owner:
 - 1. Contract
 - 2. Performance/payment bond as described in Article 12.
 - 3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 21. If provided, the certificates of insurance shall comply with the requirements of Article 21.
 - 4. Written Affirmative Action Plans as required in Article 6.
 - 5. Affidavit of Work Authorization as required in Instructions to Bidders, Article 10.
 - 6. Items 1-5 above must be received by the Owner within fourteen (14) consecutive calendar days after the Contractor receives the letter directing submittal of said items. If not, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instruction to Bidders.
- B. Within ten (10) days following receipt of the "Notice to Proceed," the Contractor shall submit to the Owner for approval the following:
 - 1. A progress and payment schedule as described in Article 15
 - 2. A complete breakdown of the Contractor's proposal as described in Article 27.
 - 3. Personnel certifications as required in specifications.
 - 4. No payments to the Contractor will be made until the Contractor has submitted items 1, 2, and 3 above, and they have been approved by the Owner; provided, however, that should the Contractor not receive written notification from the Owner of the disapproval of any of these items within twenty-one (21) calendar days of their receipt by Owner, the Contractor may consider them approved and may proceed accordingly.

- C. Contractor shall commence work upon a date to be specified by the Owner in the "Notice to Proceed". Contractor shall prosecute the work with faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents, or pay to the Owner the damages resulting from the failure to timely complete the work as set out in Article 14. The Contractor has the right to finish the work before the contract completion date. The Owner assumes no liability for any hindrances to the Contractor unless the Owner caused delays to the contract completion date.
- D. The work shall be completed within that number of working days specified in the contract.
- E. Extension of time stipulated in the Contract for completion of the work will be made when changes in the work occur, as provided in Article 26, when the work is suspended as provided in Article 13; or when the work of the Contractor is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the Contractor, subcontractors or suppliers, and which were not the result of their fault or negligence. Extension of time for completion shall also be allowed for any delays in the progress of the work caused by any act (except as provided elsewhere in these General Conditions) or neglect of the Owner or by other Contractors employed by the Owner, or for any delay in the furnishing of drawings and necessary information by the Owner, or delay in return of shop drawings, or for any other cause which in the opinion of the Owner entitles the Contractor to an extension of time, including but not restricted to fires, floods, unusually severe weather, or labor strikes. Extension of time will be made for days that are not working days as defined herein. This determination will be documented in writing and signed by the Contractor's and Owner's representatives. If there is a failure to agree on the number of "non-work" days for a particular month, that disagreement shall be noted on this written document and signed by each party's representative. Failure of the Contractor's representative to sign the "non-work" day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the determination contained in that document.
- F. The Contractor shall notify the Owner promptly in writing and no later than within seven (7) days of any occurrence or conditions which in the Contractor's opinion entitles the Contractor to an extension of time. Following such notice the Contractor shall promptly provide all necessary supporting materials with details of any resultant costs and in ample time, but no later than thirty (30) days of occurrence, to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after investigation, the Owner shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such information within the times specified shall constitute a waiver by the Contractor of any claim.
- G. When conditions at the site of the proposed work are considered by the Owner to be unsatisfactory for prosecution of the work, Contractor may be ordered in writing to suspend the work or any part thereof until reasonable conditions exist. When such suspension is not due to fault or negligence of the Contractor, time allowed for completion of such suspended work will be extended by a period of time equal to that lost due to delay occasioned by ordered suspension.

ARTICLE 14 - LIQUIDATED DAMAGES/SUBSTANTIAL COMPLETION

- A. For each calendar day, including weekends and holidays after the number of working days specified for completion of the project that the entire work is not substantially complete, it is agreed that the Owner may deduct from the contract price and retain as liquidated damages, and not as penalty or forfeiture, the sum stipulated in the contract.
- B. When the Contractor determines the work is substantially complete, the Contractor shall request the Owner to inspect the work at least five (5) full work days before the requested inspection date. The request shall include a list of outstanding items known to the Contractor. Following the inspection, Owner shall, in Owner's sole discretion, determine whether the work is substantially complete. If the Owner determines the work is not substantially complete, the Owner shall issue a list of items to the Contractor which are incomplete or require correction before substantial completion can be issued. If the work is acceptable, the Owner shall identify all outstanding items and shall then determine that substantial completion be issued. After substantial completion is issued, the Contractor, within seven (7) calendar days, shall provide to the Owner an estimate of cost to complete or correct identified items. The Owner shall review the Contractor's estimate for reasonableness. If the Contractor fails to provide an acceptable timely estimate, the Owner's estimate shall be used. The Owner may also establish a value for the close-out documents. The Contractor shall correct all items within forty-five (45) calendar days of the date of the substantial completion unless additional time is granted by the Owner's representative. Up to 150% of the value of any identified items not satisfactorily completed within the forty-five (45) days may be deducted from the Contractor's final payment

and retained by the Owner. However, this does not relieve the Contractor of the requirements concerning final completion and of Article 33 - General Guarantee.

- C. Only certification by the Owner as to substantial completion of the work within the time specified shall be conclusive and binding on the Owner and Contractor for the purpose of determining whether or not liquidated damages shall be assessed under the terms hereof and the sum total amount due.
- D. Liquidated damages or any matter related thereto shall not relieve the Contractor or the surety of any responsibility or obligation under this contract.
- E. In the event the substantial completion is not given by the owner, the Owner may deduct the costs of reinspection from the Contractor's contract.
- F. If substantial completion has not been given by the date set forth in the contract for final completion, then the Owner, without prejudice to any other rights, claims, or remedies the Owner may have including the right to liquidated damages, may back charge the Contractor for all additional expenses incurred by the Owner as the result of the extended contract period and through final inspection.

ARTICLE 15 - PROGRESS AND SCHEDULING

- A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress the Contractor agrees to maintain and the order in which the Contractor proposed to carry on various phases of work. The schedule shall be a comprehensive, fully developed, horizontal bar-chart-type, contractor's construction schedule. The Contractor for General Construction shall prepare the construction schedule for the entire project.
- B. Values employed in preparation of any schedules will be used only for determining the basis for partial payments and will not be considered as a basis for additions to or deductions from the contract price.
- C. There will be no payments of any periodic estimates until the progress schedule has been approved by the Owner. An updated schedule to reflect actual conditions, shall be presented with the periodic estimates or as requested for approval by the Owner. Subsequent payments may be suspended if the project schedule has not been adequately updated.
- D. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

ARTICLE 16 - SUBSTITUTIONS AND "OR APPROVED EQUAL"

- A. Whenever in any of the contract documents any article, appliance, device or material is designated by the name of the manufacturer or vendor or by any proprietary or trade name and such name is followed by the words "or approved equal", "or as approved" or preceded by the words "similar and equal to", the standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.
- B. The Contractor may request the use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner is equal in all respects to that named. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those called for shall be properly made as approved by the Owner at the expense of the Contractor requesting the substitution or change.
- C. In the event the Contractor desires to substitute any article, device, product, material, fixture, form or type of construction for that specified, the Contractor shall submit a request for such substitutions in writing to the Owner within thirty (30) days after the date of the "Notice to Proceed". Thereafter no consideration will be given to alternate forms of accomplishing the work. This article does not preclude the Owner exercising the provisions of Article 26 hereof.
- D. Any request for substitution by the Contractor, or on behalf of his/her subcontractors, as provided by Article 16, shall be submitted on Material Supplier - Product Substitution Request Form included as DOCUMENT 006500 of these documents.

ARTICLE 17 - SUPERINTENDENCE

- A. The Contractor shall have at the work site at all times during the progress of any and all work, a competent superintendent satisfactory to the Owner. The Contractor shall have only one (1) named superintendent at a time whenever work is in progress. The superintendent shall represent the Contractor in the Contractor's absence and all directions given to the Superintendent shall be as binding as if given to the Contractor. The Superintendent shall carefully study and compare all drawings, specifications and other instructions and shall, at once, report to the Owner any error, inconsistency or omission which may be discovered. The superintendent shall not be changed except with the consent of the Owner by written request. **The superintendent must be an employee of the Contractor.**

ARTICLE 18 - SHOP DRAWINGS

- A. The Contractor shall submit, with such promptness as to cause no delay in the work or in that of any other contractors, all shop and setting drawings. Such drawings shall be submitted to the Owner electronically or in hard copy for the Owner's use, and additional copies as required for the Contractors, subcontractors, material suppliers, and to meet the requirements for maintenance manuals, etc., as described in Article 32.
- B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:
1. Date of Submission
 2. Name of Project
 3. Location
 4. Division of Work
 5. State Project Number
 6. Name of Submitting Contractor
 7. Name of Subcontractor
 8. Identify as either a base bid item or an alternate number
 9. Indicate if item is submitted as specified, an approved equal or as substitution.
- C. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear the stamp of the Contractor as evidence that the Contractor has received and approved them. Any shop drawings and schedules submitted without this stamp, will be returned for resubmittal and the drawings and schedules will be considered as never having been submitted.
- D. The Contractor shall include with the shop drawing, a letter indicating all deviations from the drawings and/or specifications. Failure to so notify all such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Owner, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.
- E. It is the Contractor's obligation and responsibility to check all of the shop drawings and schedules and to be fully responsible for them and for their coordination with connecting work. Shop drawings and schedules shall indicate in detail all parts of an item of work, including erection and setting instructions and engagements with the work of other trades.
- F. The Owner shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and compliance with the information given in the contract documents. The approval shall not relieve the contractor from the responsibility for deviations from the drawings and specifications, unless the Contractor has called the Owner's attention to the deviation, in writing, at the time of submission. An approval of any such modification will be given only if it is in the interest of the Owner, to affect an improvement in the work, does not increase the contract sum and/or completion time, is subject generally to all contract stipulations and covenants, and is without prejudice to any and all rights under the surety bond.
- G. No extension of time will be granted the Contractor because of their failure to submit shop drawings and schedules in ample time to allow for review and possible re-submittals. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of the approved shop drawings and schedules to all contractors whose work is in any way related to the work under the contract. Only prints bearing all approvals will be allowed on the site of construction.

- H. All shop drawings must be submitted and approved prior to the receipt of the third partial payment request. After the second payment has been made, no further payments will be made without the written consent of the Owner until all shop drawings have been submitted and approved.
- I. On completion of the work, and as a condition precedent to receiving final payment, all shop drawings and schedules of all work for all trades shall be corrected to a true and actual representation of the work actually performed, erected and installed. Drawings showing the actual installation of all underground services, utilities and structures of every description shall be furnished the Owner upon completion of the work. (See Article 31).

ARTICLE 19 - SAMPLES, TESTS AND CERTIFICATIONS

- A. The Contractor shall prepare samples of all items requested or required by the specification. Samples shall be properly identified and submitted with such promptness as to cause no delay in the work or in that of any other contractor and to allow for consideration by the Owner.
- B. Each set of samples submitted must be accompanied by a letter of transmittal containing the following information:
 - 1. Date of Submission
 - 2. Name of Project
 - 3. Location
 - 4. Section Number of Specification
 - 5. State Project Number
 - 6. Name of Submitting Contractor
 - 7. Name of Subcontractor
- C. No materials shall be delivered to the site of construction or incorporated into the work until the Contractor has received approval. Any materials installed prior to receipt of such approval shall be subject to rejection by the Owner.
- D. Samples shall be labeled to designate material or product represented, grade, place of origin, name of producer and name of Contractor.
- E. Approval of material is general and shall not constitute waiver of Owner's right to demand full compliance with contract requirements.
- F. Rejected samples will be destroyed unless the Contractor requests return of the samples at the Contractor's expense.
- G. After delivery of any materials the Owner may make such tests as is deemed necessary. The Contractor shall furnish test samples at no cost to the owner. If the material, equipment or accessory fails to meet the contract requirements, all costs of testing shall be paid by the Contractor. If the item meets the contract requirements, costs of testing will be paid by Owner.
- H. On the basis of the test results, materials, workmanship, equipment or accessories may be rejected even though general approval has been given. If the rejected items have been incorporated in work, the Owner may require the contractor to remove and replace the item with one meeting contract requirements or to demand and secure such reparation to the Owner from the Contractor as is equitable.
- I. The Owner reserves the right to require the Contractor to furnish a certificate guaranteeing that material or equipment as submitted, complies with contract requirements. Certificates shall be in notarized affidavit form.
- J. When directed by the Owner, and unless otherwise required within the technical specifications, samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels constructed at site of approximately 20 square feet each.
- K. All tests required by the specifications shall be paid for by the Contractor and performed by testing laboratories approved by the Owner.

ARTICLE 20 - MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of the best quality. If required by the Owner, satisfactory evidence shall be furnished as to the kind and quality of the materials and workmanship.

- B. All materials and workmanship used in the work shall be subject to the inspection of the Owner, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice. The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All condemned materials shall be immediately removed from the site of the work.
- C. Failure or neglect on the part of the Owner to condemn or reject bad or inferior materials or workmanship shall not be construed to imply an acceptance of any work. The work herein specified to be done is not to be considered as finally accepted until it is so stated in writing by the Owner.
- D. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.
- E. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. This must be done to the entire satisfaction of the Owner but the Contractor must assume full responsibility for the work. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect.
- F. Contractor shall, at all times, enforce strict discipline and good order among the employees, and shall not employ on the work any unfit person or any person not skilled in the work assigned to them.
- G. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of all material, equipment and apparatus into the building.
- H. Contractor shall base the proposal only on materials, method of construction and equipment as indicated. Contractor may make a written proposal to Owner to use alternate materials, methods or fixtures, in accordance with Article 16, Substitutions.
- I. Contractor shall promptly remove at their expense all rejected materials from site of work.
- J. When a material has been approved no change in brand or make will be permitted unless:
 - 1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or
 - 2. Material delivered fails to comply with contract requirements.

ARTICLE 21 – INSURANCE

- A. The successful Contractor shall procure and maintain for the duration of the contract issued a policy or policies of insurance for the protection of both the Contractor and the Owner and their respective officers, officials, agents, consultants and employees. The Owner requires certification of insurance coverage from the Contractor prior to commencing work. Please carefully review the requirements outlined below.
- B. It is highly recommended that you confer with your insurance broker/agent or other insurance company representative, prior to submitting your bid, to determine that availability and applicable cost, if any, of certificates, endorsements, coverage, and limits required.
- C. Minimum Scope and Extent of Coverage
 - 1. General Liability

Commercial General Liability, ISO coverage form number CG 00 01 ("occurrence" basic), or I-SO coverage form number CG 0002, or ISO equivalent.

If ISO equivalent or manuscript general liability coverage forms are used, minimum coverage will be as follows: Premises/Operations; Independent Contractor; Products/Completed Operations; personal Injury; Broad Form Property Damage including Completed Operations; Broad Form Contractual Liability Coverage to include Contractor's obligations under Article 25 Indemnifications.
 - 2. Automobile Liability

Business Automobile Liability Insurance, ISO Coverage form number CA 00 01 covering automobile liability, code 1 "ANY AUTO".

3. Workers' Compensation and Employer's Liability

Statutory Workers' Compensation Insurance for Missouri, endorsement for incidental contact and standard Employer's Liability Insurance is required where applicable. Endorsement for incidental contact and specific incidental coverage is required for construction on or over U.S. waterways, pursuant to the United States Longshore Harbor Workers' Compensation Act.

4. Builder's Risk Insurance

Insurance upon the work and all materials, equipment, supplies, temporary structures and similar items which may be incident to the performance of the work and located at or adjacent to the site, against loss or damage from fire and such other casualties as are included in extended coverage in broad "All Risk" form, including coverage for Flood and Earthquake, in an amount not less than the replacement cost of the work or this contract price, whichever is greater, with loss payable to Contractor and Owner as their respective interests may appear.

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

D. Minimum Limits of Insurance

1. General Liability

Contractor

\$2,000,000 Combined single limit per occurrence for bodily injury, personal injury, and property damage.

\$2,000,000 Annual aggregate

Subcontractor

\$1,000,000 Combined single limit per occurrence for bodily injury, personal injury, and property damage

\$1,000,000 Annual aggregate

2. Automobile Liability

\$2,000,000 Combined single limit per occurrence for bodily injury and property damage

3. Workers' Compensation and Employers Liability

Workers' Compensation limits as required by applicable State Statutes (generally unlimited) and minimum of \$1,000,000 limit per accident for Employer's Liability.

General Liability and Automobile Liability insurance may be arranged under individual policies for the full limits required or by a combination of underlying policies with the balance provided by a form-following Excess or Umbrella Liability policy.

E. Deductibles and Self-Insured Retentions

All deductibles, co-payment clauses, and self-insured retentions must be declared to and approved by the Owner. The Owner reserves the right to request the reduction or elimination of unacceptable deductibles or self-insured retentions, as they would apply to the Owner, and its commissioners, officers, officials, agents, consultants and employees. Alternatively, the Owner may request Contractor to procure a bond guaranteeing payment of losses and related investigations, claims administration, and defense expenses.

F. Other Insurance Provisions and Requirements

The respective insurance policies and coverage, as specified below, must contain, or be endorsed to contain the following conditions or provisions:

1. General Liability

The Owner, and its commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insureds by ISO form CG 20 26 Additional Insured - Designated Person or Organization. As additional insureds, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insureds. Insurance of self-insurance programs maintained by the designated additional insureds shall be excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's general liability insurer shall agree to waive all rights of subrogation against the Owner and any of its commissioners, officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner, or for any of its commissioners, officers, officials, agents, consultants or employees.

2. Automobile Insurance

The Owner, and its commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insureds by ISO form CA 20 48 - Additional Insured Designated Person or Organization. As additional insureds, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insureds. Insurance or self-insurance programs maintained by the designated additional insureds shall be in excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's automobile insurer shall agree to waive all rights of subrogation against the Owner and any of its commissioners, officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner or for any of its commissioners, officers, officials, agents, consultants or employees.

3. Workers' Compensation/Employer's Liability

Contractor's workers' compensation insurance shall be endorsed with ISO form WC 00 03 01 - Alternate Employer Endorsement. The Alternate Employer Endorsement shall designate the Owner as "alternate employers."

4. All Coverage

Each insurance policy required by this document of the Contract shall contain a stipulation, endorsed if necessary, that the Owner will receive a thirty (30) day advance notice of any policy cancellation other than cancellation for non-payment of premium. Ten (10) days advance notice is required for policy cancellation due to non-payment of premium.

G. Insurer Qualifications and Acceptability

Insurance required hereunder shall be issued by an A.M. Best, "B+" rated, Class IX insurance company approved to conduct insurance business in the state of Missouri.

H. Verification of Insurance Coverage

Prior to Owner issuing a "Notice to Proceed," the Contractor shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Director. The Owner reserves the right to require certified copies of all required policies at

any time. If the scope of this contract will exceed one (1) year or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract, the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder.

If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

ARTICLE 22 - SEPARATE CONTRACTS AND COOPERATION

- A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate the Contractor's work with theirs.
- B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner before the work is performed. If the Contractor fails to do this and constructs any work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner, at no additional cost to the Owner.
- C. No contractor or subcontractor shall delay any other contractor or subcontractor by neglecting to perform work at the proper time. Each contractor or subcontractor shall be required to coordinate all work with other contractors and subcontractors so as to afford others reasonable opportunity for execution of their work. If any contractor or subcontractor causes delay to another, that contractor or subcontractor shall be liable directly to that contractor or subcontractor for such delay in addition to any liquidated damages which might be due the Owner.
- D. Each Contractor shall be responsible for damage to Owner's or other Contractor's property by them or workers in their employ through fault or negligence.
- E. Should a Contractor sustain any damage through any act or omission of any other contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such contractor. The phrase "acts or omissions" as used in this document shall be defined to include, but not be limited to, any unreasonable delay on the part of any such Contractors.

ARTICLE 23 - SUBCONTRACTS

- A. Subcontractor assignments as identified in the bid proposal shall not be changed without written approval of the Owner. The Owner may not approve changes of a listed subcontractor unless the subcontractor cannot or will not perform the work as specified.
- B. The Contractor agrees to accept full responsibility to the Owner for the acts and omissions of any subcontractors or persons either directly or indirectly employed by them.
- C. Every subcontractor shall be bound by the applicable terms and provisions of the contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or the contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.
- D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Owner in writing of the names of any subcontractors to be used in addition to those identified in the bid proposal and all major material suppliers proposed for all parts of the work. Any additional material supplier shall be submitted on Material Supplier - Product Substitution Request included as DOCUMENT 006500. Any subcontractor substitution shall be submitted on Subcontractor Substitution - Additional Request included as DOCUMENT 006510.

ARTICLE 24 - ASSIGNMENT OF CONTRACT

- A. No assignment by Contractor of any amount or any part of this contract or of the funds to be received there under will be recognized unless such assignment has had the written approval of the Owner and the surety has been given due notice of such assignment and has furnished written consent thereto. In addition to the usual recitals in assignment contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the

contract and to claims or liens for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials".

ARTICLE 25 - INDEMNIFICATION

- A. Contractor agrees to indemnify and save harmless Owner and its commissioners, officers, officials, agents, consultants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner and its commissioners, officers, officials, agents, consultants and employees, in defense of any claim, action or suit, irrespective of any claims that an act, omission or negligence of Owner or its commissioners, officers, officials, agents, consultants or employees contributed to such injury or damage.
- B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Owner, and its commissioners, officers, officials, agents, consultants and employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, design or specifications, or (2) giving of or the failure to give directions or instructions by the Owner, and its commissioners, officers, officials, agents, consultants and employees, as required by the contract documents provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 26 - CHANGES IN THE WORK

- A. The Owner and no other, without giving notice to the surety and without invalidating the contract, may order extra work or make changes by altering, adding to or deducting from the work, the contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.
- B. The amount of any adjustment in the contract price for authorized changes shall be agreed upon before such changes or authorizations become effective and shall be determined, through submission of a request for proposal prepared by the Owner, as follows:
 - 1. By unit prices contained in Contractor's original proposal and incorporated in the construction contract.
 - 2. By an acceptable unit price or lump sum proposal from Contractor and subcontractor. Proposal shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
 - 3. By a cost-plus-fixed-fee (percentage) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
- C. Overhead and Profit on Change Orders and Field Work Authorizations shall be applied as follows:
 - 1. The overhead and profit charged by the Contractor and all subcontractors shall be considered to include, but is not limited to: performance/payment bond, job site office expense, incidental job burdens, truck expense including mileage, small hand tools, project supervision including field supervision, company benefits and general office overhead. The percentages for overhead and profit charged on Change Orders and Field Work Authorizations shall be negotiated and may vary according to the nature, extent and complexity of the work involved. However, the overhead and profit for the Contractor or subcontractor actually performing the work shall not exceed 15%. When one or more tiers of subcontractors are used, in no event shall any Contractor or subcontractor receive as overhead and profit more than 7% of the cost of the work performed by any of his/her subcontractors. In no case shall the total overhead and profit paid by the Owner on any Change Order exceed twenty five percent (25%) of the cost of materials, labor and equipment necessary to put the change order work in place. Equipment rental shall be paid at the rates listed in the Contractor-Subcontractors Equipment List, or at the Owner's option at other rates agreed upon in writing. Equipment rental rates shall include all costs, including operators, fuel, and all other operating costs. If the equipment is not on the project grounds, an allowance will be made for mobilization. No percentage markup shall be applied to those equipment rental rates listed in the Contractor-Subcontractors Equipment List. The percentage markups provided

herein are intended to include the costs associated with all delay, disruption, extended job site presence and home office overhead resulting from the changed work.

2. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.
 3. The percentages for overhead and profit credit to the Owner on Change Orders that are solely decreases in the quantity of work or materials shall be negotiated, and may vary according to the nature, extent and complexity of the work involved, but in no case shall be less than ten percent (10%).
- D. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order work performed by force account or accounts. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined in paragraph C above. The Project Manager shall approve the Contractor's daily time and material invoices for the work involved.
- E. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.
- F. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Owner, is hereby permitted to act at their discretion to prevent such threatened loss or injury. Any compensation claimed by the Contractor on account of such emergency work shall be submitted in writing and determined by agreement with the Owner.

ARTICLE 27 - PAYMENT TO CONTRACTORS

- A. **PAYMENTS: All required contract forms pertaining to payment shall be on MDC forms included within this contract document.**
1. Payments on account of this contract will be made monthly in proportion to the work which has been completed subject to the retainage requirements set forth below. For contracts in an amount greater than or equal to \$100,000 refer to Article 34 for Minority Report requirements. Request for payment must be submitted on the Owner's form as provided. No other pay request will be processed. Supporting breakdowns must be provided if requested by the Owner. The Owner shall make payment within (30) days after the application and certification for payment is approved. The Owner reserves the right to reduce the amount of the payment, as requested, if the Owner determines that the work has not progressed to the level claimed by the Contractor. The Owner shall retain five (5) percent of the amount of each such payment application until final completion and acceptance of all work covered by this contract. Upon the issuance of a certificate of substantial completion, the Contractor shall provide the Owner with a price to complete any outstanding work items. Upon receipt of these prices, the Contractor may request release of retainage in excess of 150% of the value of the outstanding work items.
 2. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. No such payment shall be deemed to be approval for any item or items for which such payment is made, and this provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.
 3. Materials delivered on site of work and not incorporated in work if suitably stored on the site or in an approved warehouse in accordance with the requirements of Section 8.310 Missouri Revised Statutes 1994 and Cumulative Supplements, will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage in effect, providing:
 - a. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 18 of General Conditions.
 - b. Delivery is made in accordance with the time frame on the approved schedule.
 - c. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.

- d. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.
- 4. The Contractor shall be allowed to include in the application and certification for payment, one hundred (100%) of the value, subject to retainage, of major equipment and material stored off the site if all of the following conditions are met:
 - a. The request for consideration of payment for materials stored off site is made at least 21 days prior to submittal of the Application for Payment including such material.
 - b. Materials stored in one location off site are valued in excess of \$25,000.
 - c. That a Certificate of Insurance is provided indicating adequate protection from loss, theft conversion or damage in transit for materials stored off site. This Certificate shall show the Missouri Department of Conservation as an additional insured for this loss.
 - d. The materials are stored in a facility approved and inspected, by the Owner's representative.
 - e. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.

B. PAYMENTS WITHHELD: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:

- 1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or items. The cost of corrective action(s) shall be borne by the Contractor.
- 2. A reasonable doubt that this contract can be completed for the balance then unpaid.
- 3. Failure of the Contractor to provide certified copies of all weekly payroll records, on the standard form included in this contract as "Certified Payroll Records" for the time period covered by the pay estimate.
- 4. Failure of the Contractor to update the schedule.

When the Owner is satisfied the Contractor has remedied above grounds, for withholding payment, payment shall be made for amounts withheld.

C. FINAL PAYMENT: All required contract forms pertaining to payment shall be on MDC forms included within this contract document.

- 1. Final payment shall be due at such time as the work is fully completed and all provisions of the contract have been satisfactorily fulfilled. An amount equal to 150% of the value of the incomplete items may be deducted from the final payment per Article 14.
- 2. Upon receipt of written notice from the Contractor to the Owner that the work is ready for final inspection and acceptance, the Project Manager shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Contractor will be directed to submit a final estimate for certification. If the Owner approves the same, the entire balance shall be due and payable.
- 3. Where the specifications provide for the performance by the Contractor of certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of weather conditions, such test shall be considered as required under the provisions of the specifications, Article 19 of General Conditions, and the contract may be certified as satisfactorily completed and the work accepted. However, full payment will not be made until the tests have been made. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment as noted in Article 14.
- 4. Neither the final payment nor any part of the retained percentage shall become due until the Contractor delivers to the Owner the complete file of applicable forms included within this contract document in the proper form and order for all contractor, subcontractors, and material suppliers: 1) Document 006200-Affidavit Compliance With Prevailing Wage Law, 2) Document 006310-Affidavit for Final Payment, 3) Document 006410-Final Receipt of Payment and Release or release from the bond company accepting liability for any unpaid amounts, 4) Document 006450-Certified Payroll Records, 5) as-built documents

(redlines), and 6) Warranties and Operating Instructions. **All required contract forms listed within this paragraph and pertaining to payment shall be on Missouri Department of Conservation forms which are included within this contract document.**

- D. If any lien or claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a lien or claim including all costs and a reasonable attorney's fee.
- E. The Contractor shall remove all Contractor's equipment, furnishings, and materials from the work site within thirty (30) days after receipt of final payment. The Owner, on failure of Contractor to remove said equipment and etc., upon giving the Contractor written notice and thirty (30) days to remove the equipment and etc., may have the equipment impounded and stored. The equipment and etc., will be released to the Contractor upon payment of damage and storage cost.

ARTICLE 28 - PARTIAL OCCUPANCY/SUBSTANTIAL COMPLETION.

- A. When the Contractor believes that the Work, or any part of it which the Owner desires to accept separately, is substantially complete, the Contractor shall so notify the Owner. The Owner shall conduct an inspection of the Work. The Owner shall prepare a list of all outstanding items of Work or corrections to the Work which need to be completed ("Punch List"). If, in the opinion of the Owner, the Work is not substantially complete, the Owner shall specify those items which must be satisfactorily completed before a certificate of Substantial Completion shall be issued. The Contractor shall notify the Owner when these items are complete so that another inspection can be made.
- B. The Owner shall determine when the project is substantially complete and shall issue a certificate of substantial completion which shall establish the date of Substantial Completion and shall set forth the responsibilities of the Owner and the Contractor for utilities, security maintenance, damage to the work and risk of loss. The Certificate of Substantial Completion shall also set the time for completion of all remaining items of outstanding work.
- C. Contractor agrees that Owner, upon advance notification to Contractor in writing, will be permitted to occupy and use any completed or partially completed portions of the project when such occupancy and use is to the Owner's best interest. If such prior occupancy increases the cost of the work or delays its completion, provided that the same occur prior to the completion date fixed by the "Notice to Proceed", and as amended by contract change orders, and provided the Contractor submits written notification of such cost increase or time delay, the Contractor shall be entitled to extra compensation or extension of time, or both.

ARTICLE 29 - DISPUTES AND DISAGREEMENTS.

- A. In order to prevent all disputes or disagreements between the parties aforesaid in relation to the performance hereof of this Contract, it is hereby expressly agreed and understood that in case any controversy or difference of opinion shall arise as to the quantity or value of the work, or material, the interpretation of plans, specifications and provisions of the contract documents, or any other matter connected with the work, or the performance of the covenants and agreements herein contained, the decision of the Owner shall be final and binding on all parties.

ARTICLE 30 - TERMINATION OR SUSPENSION FOR CAUSE

- A. If the Contractor shall file for bankruptcy, or if the Contractor should make a general assignment for the benefit of the Contractor's creditors, or if a receiver should be appointed on account of the Contractor's insolvency, or if the Contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workers or proper materials or if the Contractor should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of the contract, then the Owner may serve notice on the Contractor and the Contractor's surety setting forth the violations and demanding compliance with the contract. Unless within ten (10) consecutive calendar days after serving such notice, such violations shall cease and satisfactory arrangements for correction be made, the Owner may suspend the Contractor's right to proceed with the work or terminate the contract.
- B. In the event the Owner suspends Contractor's right to proceed with the work or terminates the contract, the Owner may demand that the Contractor's surety take over and complete the work on the contract, after the surety submits a written proposal to the Owner and receives written approval and upon the surety's failure or refusal to do so within ten (10) consecutive calendar days after demand therefore, the Owner may take over

the work and prosecute the same to completion and the Owner may take possession of and utilize in completing the work such materials, supplies, appliances and plant as may be on the site of the work, and all subcontractors, if the Owner elects, shall be bound to perform their contracts.

- C. The Contractor and the surety shall be and remain liable to the Owner for any excess cost or damages occasioned to the Owner as a result of the actions above set forth.
- D. The Contractor in the event of such suspension or termination shall not be entitled to receive any further payments under the contract until the work is wholly finished. Then if the unpaid balance under the contract shall exceed all expenses of the Owner, such excess shall be paid to the Contractor; but, if such expenses shall exceed the unpaid balance as certified by the Owner, the Contractor and the surety shall be liable for and shall pay the difference and any damages to the Owner.
- E. In exercising Owner's right to secure completion of the work under any of the provisions hereof, the Owner shall have the right to exercise Owner's sole discretion as to the manner, methods and reasonableness of costs of completing the work.
- F. The rights of the Owner to suspend or terminate as herein provided shall be cumulative and not exclusive and shall be in addition to any other remedy provided by law.
- G. The Contractor in the event of such suspension or termination may be declared ineligible for Owner contracts for a minimal period of twelve (12) months. Further, no contract will be awarded to any Contractor who lists in the proposal any subcontractor whose prior performance has contributed, as determined by the Owner, to a breach of a contract. In order to be considered for State awarded contracts after this period, the contractor/subcontractor will be required to forward acceptance reports to the Owner regarding successful completion of non-State projects during the intervening twelve (12) months from the date of default. No State contracts will be awarded to a subcontractor/contractor until the ability to perform responsibly in the private sector has been proven to the Owner.

ARTICLE 31 - RECORD DRAWINGS.

- A. Contractors shall, at the completion of their work and prior to submission of request for final payment, complete and turn over to the Owner a marked up set of the drawings provided for construction. The corrections shall show any addenda and all field changes that were made to adapt to field conditions, changes resulting from contract change orders and all buried installations of piping, conduit, and utility services. All buried and concealed items both inside and outside shall be accurately located as to depth and referenced to two permanent features such as interior or exterior wall faces and dimensions shall be given in a neat and legible manner in a contrasting colored pencil or ink.

ARTICLE 32 - WARRANTIES AND OPERATING INSTRUCTIONS.

- A. Warranties and operating instructions of all equipment items, according to the manufacturer's policy covering their products, shall be delivered in two (2) copies to the Owner prior to submission of the final pay estimate.

ARTICLE 33 - GENERAL GUARANTEE.

- A. Neither the final certificate of payment or any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with the contract documents or relieve the Contractor or the sureties of liability in respect to any latent defects, express warranties or responsibility for faulty materials, workmanship or liquidated damages.
- B. The Contractor or the sureties shall remedy any defects in the work and pay for any damage to other work resulting therefrom which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified. The Owner will give notice of observed defects with reasonable promptness.
- C. In case of default on the part of the Contractor in fulfilling this part of the contract, the Owner may correct the work or repair the damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor and/or surety.
- D. Should Contractor be required to perform tests that due to climatic conditions must be delayed, it is understood that such tests will be accomplished by Contractor at the earliest possible date with the provisions of the General Guarantee beginning upon satisfactory completion of said test.

- E. Contractor warrants and guarantees that the work will be free from defects, and that the work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment installed.

ARTICLE 34 - MBE/WBE REQUIREMENTS

For contracts in an amount greater than or equal to one hundred thousand dollars (\$100,000), the following provisions shall apply:

- A. The Contractor shall have a goal of subcontracting not less than the percent indicated in the awarded contract to MBE/WBE (s).
- B. If the Contractor fails to meet or maintain stated percent, the Contractor must satisfactorily explain to the Owner why the goals cannot be achieved and why meeting the goals were beyond the Contractor's control.
- C. If the Owner finds the Contractor's explanation unsatisfactory, the Owner may take any appropriate action including, but not limited to:
1. Declaring the Contractor ineligible to participate in any state contracts administered through the Missouri Department of Conservation for a period not to exceed six (6) months; and
 2. Directing that the Contractor be declared in breach of the contract.
- D. If a MBE/WBE is replaced during the course of the contract, the Contractor shall make a good faith effort to replace it with another MBE/WBE. All substitutions shall be approved by the Owner.
- E. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE obligations. As a minimum, the dollar-value of work completed by each MBE/WBE subcontractor during the preceding month and as a cumulative total shall be reported with each monthly application for payment. A final report shall include the total dollar-value of work completed by each minority subcontractor during the total contract.

ARTICLE 35 - DOMESTIC PRODUCTS PROCUREMENT

- A. In accordance with Section 34.353 RSMo., any manufactured goods or commodities used or supplied in the performance of this contract or any subcontract thereto shall be manufactured, assembled or produced in the United States, unless the specified products are not manufactured, assembled or produced in the United States in sufficient quantities to meet the agency's requirements or cannot be manufactured, assembled or produced in the United States within the necessary time in sufficient quantities to meet the contract requirements, or if obtaining the specified products manufactured, assembled or produced in the United States would increase the cost of this contract for purchase of the product by more than ten percent.
- B. The Contractor shall certify, through each pay application, that all manufactured goods or commodities used or supplied in the performance of the work for which payment is requested were manufactured, produced or assembled in the United States. If the goods used or supplied in the performance of the work for which payment is requested were not manufactured, produced or assembled in the United States, the Contractor must certify that the goods needed (1) are not manufactured in the United States, (2) are not manufactured in sufficient quantities to meet the needs of this contract, (3) cannot be manufactured, assembled or produced in the United States within the necessary time to meet the requirements of this contract, or (4) would increase the cost of this contract for the purchase of the product by more than ten percent (10%) if purchased from a manufacturer or producer in the United States.

ARTICLE 36 - TERMINATION OR SUSPENSION FOR CONVENIENCE

- A. The Owner may terminate or suspend the Contract or any portion of the Work without cause at any time, and at the Owner's convenience. Notification of a termination or suspension shall be in writing and shall be given to the Contractor and his/her surety. If the Contract is suspended, the notice will contain the anticipated duration of the suspension or the conditions under which work will be permitted to resume.
- B. Upon receipt of notification, the Contractor shall:
1. Cease operations when directed.
 2. Take actions to protect the work and any stored materials.

3. Place no further subcontracts or orders for material, supplies, services or facilities except as may be necessary to complete the portion of the Contract that has not been terminated. No claim for payment of materials or supplies ordered after the termination date shall be considered.
 4. Terminate all existing subcontracts, rentals, material, and equipment orders.
 5. Settle all outstanding liabilities arising from termination with subcontractors and suppliers.
 6. Transfer title and deliver to the Owner, work in progress, completed work, supplies and other material produced or acquire for the work terminated, and completed or partially completed plans, drawings information and other property that, if the Contract had been completed, would be required to be furnished to the Owner.
- C. For termination without cause and at the Owner's convenience, in addition to payment for work completed prior to date of termination, the Contractor may, in Owner's sole discretion, receive payment for documented costs directly associated with the early termination of the contract. Payment for anticipated profit and un-applied overhead will not be allowed.

ARTICLE 37 – VENUE

- A. The Parties agree that any action, proceeding, or counterclaim brought by any party to this agreement against the other on, or in respect of, any matter whatsoever arising out of or in any way connected with this Agreement, the relationship of the parties hereunder, or any claim of involving work to be performed under this Agreement shall be brought in Cole County, Missouri, which in all cases shall be the only proper venue.

ARTICLE 38 – ADDITIONAL CONDITIONS AND INFORMATION

A. FURNISHING CONSTRUCTION DOCUMENTS:

1. The Owner will furnish the Contractor up to five (5) complete sets of drawings and specifications at no charge.
2. The Owner will furnish the Contractor up to five (5) sets of explanatory or change drawings at no charge.
3. The Contractor may make copies of the documents as needed with no additional cost to the Owner.

B. PREVAILING WAGE LAW

1. PREVAILING WAGE LAW - SECTION 290.250

The Contractor shall forfeit as a penalty to the state, county, city and county, city, town, district or other political subdivision on whose behalf the contract is made or awarded, one hundred dollars per day for each workman employed, for each calendar day, or portion thereof, such workman is paid less than the said stipulated rates for any work done under said contract, by him or by any subcontractor under him.

2. PREVAILING WAGE LAW - SECTION 290 RSMo

Each Contractor or subcontractor shall file with the contracting public body upon completion of the public work and prior to final payment therefore an affidavit stating that he had fully complied with the provisions and requirements of this Prevailing Wage Law and no public body shall be authorized to make final payment until such affidavit is filed therewith in proper form and order.

C. FEDERAL GRANTS PROJECTS:

The following criteria shall be in force for Federally funded projects:

1. COPELAND REGULATIONS ANTI-KICKBACK

The Contractor shall comply with the Copeland Regulations of the U.S. Secretary of Labor (29 CFR Part 3) which are incorporated herein by reference.

2. PAYROLL RECORDS

- a. Payroll records shall be maintained during the course of the work, and preserved for a period of three (3) years thereafter, for all laborers and mechanics working at the site of the work. The records shall contain the name and address of each employee, his correct classification, rate of pay, daily and weekly number of hours worked, deductions made, and actual wages paid.

- b. If requested by the Owner, a certified copy of all payrolls shall be submitted weekly to the Owner. The Contractor shall be responsible for submission of certified copies of the payrolls of all subcontractors. The certifications shall affirm that the payrolls are correct and complete.

3. EQUAL OPPORTUNITY CLAUSE

During the performance of the contract, the Contractor agrees as follows:

- a. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, national origin. The Contractor will take affirmative action to insure that applicants are employed and that employees are treated during employment, without regard to their race, creed, color, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.
- b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.
- c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d. The Contractor will comply with all provisions of Executive Order No. 10925 of March 6, 1961, as amended, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity (hereinafter referred to as the Committee) created thereby.
- e. The Contractor will furnish all information and reports by Executive Order No. 10925 of March 6, 1961, as amended, and by the rules, regulations, and orders of the said committee, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the committee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- f. In the event of the Contractor's noncompliance with the non-discrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further government contracts in accordance with procedures authorized in Executive Order No. 10925 of March 6, 1961, as amended, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.
- g. The Contractor will include the provisions of the foregoing paragraphs A. through G. in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order No. 10925 of March 6, 1961, as amended, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontractor or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance. Provided, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

D. Contact Information:

Owner:

Missouri Department of Conservation
Design and Development Division
2901 West Truman Blvd.
PO Box 180
Jefferson City, MO 65102-0180
Telephone: 573-522-4115
Fax: 573-522-2324

Project Manager:

Jonathan W. Thompson, AIA
Design and Development Division
Telephone: 573-522-4115 ext. 3758
Fax: 573-522-2324
E-mail: jon.thompson@mdc.mo.gov

Contract Specialist:
(Bidding & Contract Execution)

Greg Trinkle
Design and Development Division
Telephone: 573-522-0136
Fax: 573-522-2324
E-mail: Greg.Trinkle@mdc.mo.gov

Contract Technician:
(Certified Payroll & Project Closeout)

Sandy Payne
Design and Development Division
Telephone: 573-522-4115 ext. 3748
Fax: 573-522-2324
E-mail: Sandy.Payne@mdc.mo.gov

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DOCUMENT 009113 – ADDENDA

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101419	Dimensional Letter Signage	4
102113	Phenolic-Core Toilet Compartments	5
102239	Folding Panel Partitions	4
102800	Toilet and Bath Accessories	3
104413	Fire Protection Cabinets	4
104416	Fire Extinguishers	3

DIVISION 11-EQUIPMENT

111313	Loading Dock Bumpers	2
115213	Projection Screens	2

DIVISION 12-FURNISHINGS

122413	Roller Window Shades	4
123661	Solid Surfacing Countertops	4

DIVISION 13-SPECIAL CONSTRUCTION Not Used**DIVISION 14-CONVEYING EQUIPMENT** Not Used**DIVISION 21-FIRE SUPPRESSION**

See Section 223000 Fire Protection System

DIVISION 22-PLUMBING

220100	General Mechanical Requirements	6
220500	Basic Mechanical Materials and Methods	6
220600	Hangers and Supports	3
220800	Piping Insulation	3
220850	Ductwork Insulation	2

221100	General-Duty Valves	2
221113	Facility Water Distribution Piping	11
221400	Piping Systems	6
221500	Geothermal Well Field Systems	3
221850	Hydronic Pumps	2
221890	HVAC Water Treatment	1
223000	Fire Protection Systems	4
224100	Plumbing Fixtures	3
224300	Plumbing Specialties	2
224850	Water Heaters	2
227330	Energy Recovery Ventilators	2
227790	Indoor Water Source Heat Pumps	3
228150	Metal Ductwork	5
228200	Duct Accessories and HVAC Specialties	2
228350	Power Ventilators	1
228550	Diffusers, Registers, and Grilles	2
229000	Building Managements System	24
229300	Mechanical Systems Commissioning	1
229500	Testing, Adjusting, and Balancing	8

DIVISION 23-HEATING VENTILATING AND AIR CONDITIONING Not Used

DIVISION 26- ELECTRICAL

260100	General Electrical Requirements	7
260500	Basic Electrical Materials and Methods	4
260600	Grounding and Bonding	2
260720	Electrical Supports	2
260750	Electrical Identification	1
261200	Conductors and Cables	2
261300	Raceways and Boxes	4
261400	Wiring Devices	2
261450	Lighting Control Devices	2
264100	Safety Switches	1
264420	Panelboards	5
265110	Lighting Fixtures	2
266100	Data and Communications	14
269000	Fire Detection and Alarm System	15

DIVISION 27-COMMUNICATIONS Not Used

DIVISION 28-ELECTRONIC SAFETY AND SECURITY Not Used

DIVISION 31-EARTHWORK

311000	Site Clearing	5
312000	Earth Moving	14
313116	Termite Control	2

DIVISION 32-EXTERIOR IMPROVEMENTS

321216	Asphalt Pavement	9
321313	Concrete Paving	14
321316	Decorative Concrete Paving	11
321373	Concrete Paving Joint Sealants	5
328400	Planting Irrigation	8
329113	Soil Preparation	9
329200	Turf & Grasses	9
329300	Plants	14

DIVISION 33-UTILITIES

334100	Storm Utility Drainage Piping	9
334600	Subdrainage	3

TECHNICAL SPECIFICATIONS INDEX:**VOLUME 3 of 3****SHEPHERD OF THE HILLS FISH HATCHERY STORAGE BUILDING IMPROVEMENTS
PROJECT JOB NUMBER 56-01-64****DIVISION 2-EXISTING CONDITIONS**

024116	Structure Demolition	5
024120	Water Supply Well Abandonment	2

DIVISION 3-CONCRETE

033000	Cast-in-Place Concrete	17
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DIVISION 4-MASONRY Not Used**DIVISION 5-METALS**

055000	Metal Fabrications	7
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DIVISION 6-WOOD, PLASTICS, AND COMPOSITES

061000	Rough Carpentry	7
061600	Sheathing	3
061760	Metal-Plate-Connected Wood Trusses	5
062013	Exterior Finish Carpentry	5
064020	Interior Architectural Woodwork	10
066400	Plastic Paneling	3

DIVISION 7-THERMAL AND MOISTURE PROTECTION

072100	Building Insulation	5
074113	Metal Roof Panels	10
074213	Metal Wall Panels	8
076200	Sheet Metal Flashing and Trim	8
078413	Penetration Firestopping	6
079200	Joint Sealants	7

DIVISION 8-OPENINGS

081100	Steel Door and Frames	5
083613	Sectional Doors	9
085200	Wood Windows	7
087100	Door Hardware	12

DIVISION 9-FINISHES

092600	Gypsum Board Assemblies	5
096530	Resilient Wall Base and Accessories	4
099120	Interior Painting	5

DIVISION 10-SPECIALTIES

101400	Signage	6
105220	Fire Extinguishers, Cabinets, and Accessories	2
108010	Toilet and Bath Accessories	5

DIVISION 11-EQUIPMENT Not Used**DIVISION 12-FURNISHINGS** Not Used**DIVISION 13-SPECIAL CONSTRUCTION** Not Used**DIVISION 14-CONVEYING EQUIPMENT** Not Used**DIVISION 21-FIRE SUPPRESSION** Not Used**DIVISION 22-PLUMBING**

220000	General Requirements for Plumbing	4
220050	Basic Mechanical Materials and Methods for Plumbing	7
220410	Plumbing Piping	8
221101	Boring and Jacking	3
221113	Facility Water Distribution Piping	13
221313	Sewage Lines and Manholes	3
224400	Plumbing Fixtures and Specialties	7

DIVISION 23-HEATING VENTILATING AND AIR CONDITIONING

230000	General Requirements for HVAC	4
230500	Basic Mechanical Materials and Methods	5
230762	Unit Heaters	3
230838	Power Ventilators	2

DIVISION 26- ELECTRICAL

260500	Common Work Results for Electrical	6
260519	Low-Voltage Electrical Power Conductors and Cables	3
260526	Grounding and Bonding for Electrical Systems	3
260533	Raceway and Boxes For Electrical Systems	5
260750	Voice and Data Communication	9
262416	Panelboards	6
262726	Wiring Devices	4
262816	Enclosed Switches	3
265119	LED Interior Lighting	4

DIVISION 27-COMMUNICATIONS Not Used**DIVISION 28-ELECTRONIC SAFETY AND SECURITY** Not Used**DIVISION 31-EARTHWORK**

311000	Site Clearing	3
312000	Earth Moving	13

DIVISION 32-EXTERIOR IMPROVEMENTS

329200	Turf and Grasses	4
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DIVISION 33-UTILITIES

330500	Common Work Results for Utilities	8
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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. **NOTE:** Procedural and protocol directives in Document 007000 - General Conditions supersede requirements of all specification sections. Please verify and comply with the requirements of the General Conditions.
- B. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work by Owner.
 - 4. Work under separate contracts.
 - 5. Future work.
 - 6. Work sequence
 - 7. Owner-furnished products.
 - 8. Contractor's use of premises.
 - 9. Owner's Occupancy requirements
 - 10. Work restrictions.
 - 11. Specification formats and conventions.
 - 12. Miscellaneous provisions.
- C. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Shepherd of the Hills Fish Hatchery – Two projects to be bid as one package:
 - Conservation Center Replacement, Project No. 56-01-71
 - Storage Building Improvements, Project No. 56-01-64
- 1. Project Location: Shepherd of the Hills Fish Hatchery, Taney County, Missouri – 483 Hatchery Road, Branson, MO 65616. Shepherd of the Hills Fish Hatchery is located six miles southwest of Branson on Highway 165 just below Table Rock Dam. (417) 334-4865
- B. Owner: Missouri Department of Conservation, P.O. Box 180, 2901 W Truman Blvd., Jefferson City, MO 65102-0180.
- C. Project Manager: Jonathan W. Thompson, AIA; 2901 W Truman Blvd., Jefferson City, MO 65109; Office: (573) 522-4115 Ext. 3758; Email: Jon.Thompson@mdc.mo.gov

- D. Owner's Consultants: The Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Plans and Specifications Design Firm: Dake Wells Architecture

Contacts: Jason Hainline, Project Manager
Dake Wells Architecture
134 Park Central Square, Suite 300
Springfield, MO 65806
PH: (417) 831-9904
Email: jhainline@dake-wells.com

Andrew Wells, Architect
Dake Wells Architecture
134 Park Central Square, Suite 300
Springfield, MO 65806
PH: (417) 831-9904
Email: awells@dake-wells.com

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:

1. SHEPHERD OF THE HILLS FISH HATCHERY – CONSERVATION CENTER REPLACEMENT, PROJECT #56-01-71

- a. The project consists of the construction of an approximately 11,776 square foot conservation center including grading and landscape enhancements, road improvements, walkable paths, and parking improvements.

2. SHEPHERD OF THE HILLS FISH HATCHERY – STORAGE BUILDING IMPROVEMENTS, PROJECT #56-01-64

- a. The project consists of the demolition of an existing field house/bunk house, construction of a new storage building, and the construction of a new 6" domestic water line and a new fire hydrant and supply line.

- B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with any work performed by Owner.

1.6 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with any work performed under separate contracts.

1.7 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. Contractor is responsible for any damage to the existing facilities. This includes, but is not limited to, the replacement of any broken pavement and the bringing back to grade of any ruts left by equipment.
 - 1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.8 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, roads, access drives, entrances, and other adjacent occupied or used facilities. Do not close or obstruct walkways, roads, access drives, entrances, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 48 hours' notice to Owner of activities that will affect Owner's operations.

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Normal work hours shall be considered the daylight hours between 6:00 am to 6:00 pm, Monday through Friday, unless otherwise approved by the Owner.
 - 1. Weekend, Holiday, and After Hours Work: The Contractor must request approval to work outside of normal work hours 48 hours in advance. Approvals of any request are at the Owner's discretion.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two (2) days in advance of proposed utility interruptions.
2. Obtain Project Engineer's written permission before proceeding with utility interruptions.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
- D. The text contained in the Specifications within the Contract Documents shall take precedence over any other materials referenced by the same if there is a conflict.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES: **SHEPHERD OF THE HILLS FISH HATCHERY – CONSERVATION CENTER REPLACEMENT, PROJECT NO. 56-01-71**

- A. General: The total sum of all unit prices shall equal the cost of constructing the complete works as shown on the Drawings and specified herein. The cost of any specific item or task not listed in the following unit prices shall be included in the nearest related unit price.
- B. The unit prices as listed in Section 004322 "Unit Prices Form," are defined as follows:
 - 1. **Mobilization & Demobilization** – Includes preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of all offices, buildings, and other facilities necessary for work on the Project except as provided in the Contract as separate unit prices; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site, and for cleanup and removal of such items from the project site. Basis of Payment shall be 60% of the lump sum price on the first pay estimate after completion of Contractor's mobilization at the site, and 40% will be included in the final payment for work under the Contract after all plant and equipment is removed from the site.
 - 2. **Site Work** - Shall include the cost for all labor, materials and equipment for the total project complete and operative as shown on the contract Drawings and as specified herein, including drainage piping, structures, grading and all other miscellaneous work not included in the other pay items. This item is measured as a complete unit of work, lump sum.

3. **Information Sign** – Includes all labor, materials and equipment necessary to furnish, install and maintain the construction information sign. This item is measured as a complete unit of work, lump sum.
4. **Full Size Materials Mock-up** – Includes all labor, materials, and equipment necessary to construct a full size material sample panel including all exterior metals, masonry (including sill configuration), siding, louvers, windows, joint sealants, and roofing. Provide the panel in a configuration representative of actual size, adjacencies, and transitions for review and approval of expected workmanship prior to installation all materials. This item is measured as a complete unit of work, lump sum.
5. **Construction Survey Staking** – Includes all labor, materials and equipment necessary to provide, install and maintain all construction survey staking and documentation required for the project, and as specified in Section 014800 "Construction Survey Staking" of the Contract Specifications. Basis of Payment shall be 90% of the lump sum price on the first estimate after completion of the Construction Layout at the site, and 10% will be included in the final payment for work under the Contract after acceptance by the Owner of all specified survey documentation.
6. **Soil Erosion Control/SWPPP** – Includes the cost for all labor for the Contractor to develop, produce, implement and maintain a Stormwater Pollution prevention Plan (SWPPP) that complies with the Contract Documents (See Section 003153 of the Project Manual). This unit price shall also include the cost for all labor, materials and equipment necessary for work in accordance with the Soil Erosion Control Plan and specified herein. Work shall include all provisions required by the SWPPP, all necessary temporary seeding and mulching, installation and maintenance of erosion control measures, and removal of temporary erosion control measures after vegetation is established and stable. Basis of Payment shall be 30% of the lump sum price on the first estimate after complete installation of erosion control measures at the site, and an additional 40% of the lump sum price at 50% work completion if controls have been properly installed and maintained according to the approved SWPPP. The remaining 30% of the lump sum price will be granted with the final payment assuming that the controls are in place; properly functioning and have been maintained according to the approved SWPPP or the site has been stabilized.
7. **Conservation Nature Center** - Shall include the cost for all labor, materials and equipment for the total project complete and operative as shown on the Contract Drawings and as specified herein, excluding all work covered under separate pay items. This item is measured as a complete unit of work, lump sum.
8. **Concrete Pavement for Entrance Road and Parking Areas** - Concrete Pavement on entrance road and parking areas as indicated on the drawings – shall include the cost for all labor, materials and equipment for providing and placing reinforced concrete pavement, and associated pavement markings, but not including adjacent sidewalks and curbs as indicated. This item is measured as a complete unit of work, lump sum.
9. **Electrical Site Work** - Shall include all labor, materials and equipment necessary to provide and install all exterior electrical conduit, conductors, grounding conductors, bedding, tracer wire and backfill base to provide a complete electrical service to all components of the project site as shown in the contract drawings and as specified herein. This item is measured as a complete unit of work, lump sum.

10. **Chain Link Fence** - Shall include all labor, materials and equipment necessary to provide all chain link fencing and gates and associated signs and appurtenances necessary to construct a complete and operable chain link fence as indicated on the drawings. This item is measured as a complete unit of work, lump sum.

3.2 SCHEDULE OF UNIT PRICES: **SHEPHERD OF THE HILLS FISH HATCHERY – STORAGE BUILDING IMPROVEMENTS, PROJECT NO. 56-01-64**

- A. General: The total sum of all unit prices shall equal the cost of constructing the complete works as shown on the Drawings and specified herein. The cost of any specific item or task not listed in the following unit prices shall be included in the nearest related unit price.
- B. The unit prices as listed in Section 004322 "Unit Prices Form," are defined as follows:
 1. **Mobilization & Demobilization** – Includes preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of all offices, buildings, and other facilities necessary for work on the Project except as provided in the Contract as separate unit prices; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site, and for cleanup and removal of such items from the project site. Basis of Payment shall be 60% of the lump sum price on the first pay estimate after completion of Contractor's mobilization at the site, and 40% will be included in the final payment for work under the Contract after all plant and equipment is removed from the site.
 2. **Site Work** - Includes the cost for all site work labor, materials and equipment for the total project complete and operative as shown on the Contract Drawings and as specified herein, excluding all work covered under separate pay items. This item is measured as a complete unit of work, lump sum.
 3. **Information Sign** – Includes all labor, materials and equipment necessary to furnish, install and maintain the construction information sign. This item is measured as a complete unit of work, lump sum.
 4. **Construction Survey Staking** – Includes all labor, materials and equipment necessary to provide, install and maintain all construction survey staking and documentation required for the project, and as specified in Section 014800 "Construction Survey Staking" of the Contract Specifications. Basis of Payment shall be 90% of the lump sum price on the first estimate after completion of the Construction Layout at the site, and 10% will be included in the final payment for work under the Contract after acceptance by the Owner of all specified survey documentation.
 5. **Soil Erosion Control/SWPPP** – Includes the cost for all labor for the Contractor to develop, produce, implement and maintain a Stormwater Pollution prevention Plan (SWPPP) that complies with the Contract Documents (See Section 003153 of the Project Manual). This unit price shall also include the cost for all labor, materials and equipment necessary for work in accordance with the Soil Erosion Control Plan and specified herein. Work shall include all provisions required by the SWPPP, all necessary temporary seeding and mulching, installation and maintenance of erosion control measures, and removal of temporary erosion control measures after vegetation is established and stable. Basis of Payment shall

be 30% of the lump sum price on the first estimate after complete installation of erosion control measures at the site, and an additional 40% of the lump sum price at 50% work completion if controls have been properly installed and maintained according to the approved SWPPP. The remaining 30% of the lump sum price will be granted with the final payment assuming that the controls are in place; properly functioning and have been maintained according to the approved SWPPP or the site has been stabilized.

6. **Storage Building Construction** - New Workshop / Storage Building - includes the cost for all labor, materials and equipment for the total project complete and operative as shown on the Contract Drawings and as specified herein, excluding all work covered under separate pay items. This item is measured as a complete unit of work, lump sum.
7. **Road Boring Steel Casing Pipe** - Includes the cost of all labor, materials and equipment required to furnish and install the bored steel casing, 6" water main carrier pipe, end seals, etc. including all excavation, compaction and cleanup as shown on the Contract Drawings and as specified herein excluding all work covered under separate pay items. Measurement shall be to the nearest linear one foot.
8. **Water Supply Well Abandonment** - Includes all labor, materials, equipment, and permits necessary to abandon and plug the domestic water supply well in accordance with MDNR regulations and as specified herein. This pay item includes the demolition of concrete water tank, well house and pump house. This item is measured as a complete unit of work, lump sum.
9. **6" Water Main and Connections** - Includes the cost of all labor, materials and equipment required to install the 6" water main complete, and includes the service connection to the exiting hatchery water system and the water service connection to the Work Shop/Storage Building. Includes furnishing and installing the pipe, fittings, air valve vault(s), excavation, pipe bedding, backfilling pipe, compaction, installing locator wires and tape, fittings, thrust blocks, concrete encasement, connection at terminal ends, testing, removal and repair of asphalt, cleanup, etc. as shown on the Contract Drawings and as specified herein, excluding all work covered under separate pay items. This item is measured as a complete unit of work, lump sum.
10. **Demolition** - Includes all labor, materials and equipment necessary for demolition of the existing field house/bunk house structure which includes; asbestos abatement, structure demolition, and disconnection of utilities, and the demolition, removal and legal disposal of the bunkhouse in accordance with EPA guidelines, and any other incidental item located within the work limits not otherwise specified in the unit price breakdown. This item is measured as a complete unit of work, lump sum.

END OF SECTION 012200

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

- 1. Coordination with Owner's:
 - a. Facility Personnel
 - b. Construction Personnel
 - c. Inspection Personnel
 - d. Design and Construction Management Personnel
 - e. Utilities companies
 - f. Other governmental entities
- 2. General coordination procedures.
- 3. Coordination drawings.
- 4. Requests for Information (RFIs).
- 5. Administrative and supervisory personnel.
- 6. Project meetings.

- B. Related Requirements:

- 1. Section 011000 "Summary".
- 2. Section 013300 "Submittal Procedures" for preparing and submitting Contractor's construction schedule.
- 3. Section 014800 "Construction Survey Staking" for procedures for field-engineering services, including establishment of benchmarks and control points.
- 4. Section 017300 "Execution" for procedures for coordinating general installation.
- 5. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Project Manager, Project Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare and submit coordination drawings in accordance with Section 1.6 of this Specification.
- B. Subcontractor/Supplier List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- C. Key Personnel Names: Within ten (10) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities. List addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors or subcontractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Project Manager indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work
2. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, curbs, and similar items.
5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.

- b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 7. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 8. Review: Project Manager will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Project Manager determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Project Manager will so inform Contractor, who shall make changes as directed and resubmit.
- 9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
 - a. Sheet Size: At least 8-½ by 11 inches but no larger than 24 by 36 inches.
 - b. Number of Copies: Submit five (5) opaque copies of each submittal. Where Coordination Drawings are required for operation and maintenance manuals, Project Manager will retain four (4) copies; remainder will be returned.
- 10. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Project Manager will return RFIs submitted to Project Manager by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Project Manager.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

- a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Project Manager. RFI Form shall remain the same throughout the duration of the contract unless otherwise modified upon the request of the Project Manager.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Project Manager's Action: Project Manager will review each RFI, determine action required, and respond. Allow ten (10) working days for Project Manager's response for each RFI. RFIs received by Project Manager after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Project Manager's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Project Manager's action may include a request for additional information, in which case Project Manager's time for response will date from time of receipt of additional information.
 3. Project Manager's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to the Contract Documents.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Project Manager in writing within ten (10) days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Project Manager.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Project Manager's response was received.
- F. On receipt of Project Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Project Manager within ten (10) days if Contractor disagrees with response.
 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

- A. General: Project Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Project Manager and Contractor will coordinate to inform participants and others involved, and individuals whose presence is required, of date and time of each meeting.
 2. Agenda: Project Manager and Contractor shall work together to develop and distribute a meeting agenda prior to the meeting.
 3. Minutes: The Project Manager will be responsible for conducting meeting, will record significant discussions and agreements achieved, and will distribute the meeting minutes to everyone concerned.
- B. Preconstruction Meeting: Project Manager will schedule and conduct a preconstruction meeting prior to issuing the "Notice to Proceed."
1. Project Manager will conduct the meeting to review responsibilities and personnel assignments.
 2. Attendees: Project Manager, Contract Supervisor, Owner's Design Consultant , and other Department Staff or Consultants as appropriate; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss Contract Documents and items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. Security.
 - w. Progress cleaning.
 - x. Other Items for discussion.
 4. Minutes: Project Manager will record and distribute meeting minutes.
- C. Progress Meetings: Project Manager will conduct progress meetings at monthly intervals, on or about the third week of the month.
1. Coordinate preparation of payment requests with dates of meetings.

2. Attendees: In addition to representatives of Owner and Project Manager, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Project Manager will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, Quality Assurance Data, Warranties, and other submittals.
- B. Related Requirements:
 - 1. Division 00 "Bidding and Contracting Requirements" for submitting:
 - a. Shop Drawings
 - b. Substitutions
 - c. Samples, Tests and Certifications
 - d. Applications for Payment and the Schedule of Values
 - e. Schedules and Reports, including Contractor's Construction Schedule
 - f. Operation and Maintenance Manuals
 - g. Record Drawings
 - h. Warranties
 - i. Closeout Documents
 - j. Subcontractor and Supplier Listing
 - k. Performance and Payment Bond
 - l. Insurance Certificates
 - m. Certified Payroll Records
 - n. MBE/WBE Reports
 - o. Affidavit Compliance with Prevailing Wage Law
 - p. Affidavit for Affirmative Action
 - q. Affidavit of Work Authorization
 - r. Final Receipt of Payment and Release
 - s. Notification Permits, etc.
 - t. Other submittals as specified
 - 2. Division 1-33 Specification Sections for requirements concerning submittals for those sections.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Project Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Project Manager's responsive action. Informational submittals may be rejected for not complying with specification requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Digital Data Source Files: Electronic digital data source files of the Contract Drawings will not be provided for Contractor's use in preparing submittals.
- B. Digital PDF Files: Electronic digital PDF data files of the Contract Drawings will be provided by the Owner for Contractor's use in preparing submittals.
 - 1. Owner will furnish Contractor one set of digital PDF data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Owner makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Project Manager reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Project Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Sequential Review: A sequential review of submittals by Owner's consultants will be required; therefore electronic transmission of the submittals will be more efficient.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Project Manager.

3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include another sequential number) after another decimal point (e.g., 061000.01.02) to indicate the number of resubmittals.
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
4. Additional Paper Copies: A total of five (5) copies are required for paper submittals, four (4) for the Owner's use and one (1) to return to the Contractor.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Project Manager will return without review submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name and number.
 - 2) Location.
 - 3) Date.
 - 4) Name of Contractor.
 - 5) Name of firm or entity that prepared submittal.
 - 6) Names of subcontractor, manufacturer, and supplier.
 - 7) Category and type of submittal.
 - 8) Specification Section number and title.
 - 9) Drawing number and detail references, as appropriate.
 - 10) Remarks.
 - 11) Identify as either a base bid item or an alternate number.
 - 12) Indicated if item is submitted as specified, an approved equal, or as a substitution.
 - 13) Signature of transmitter.

F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

- a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include a numerical suffix after another decimal point (e.g., LNHS-061000.01.02).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Project Manager.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name and number.
 - b. Location.
 - c. Date.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Remarks.
 - k. Identify as either a base bid item or an alternate number.
 - l. Indicated if item is submitted as specified, an approved equal, or as a substitution.
 - m. Signature of transmitter.
 - n. Related physical samples submitted directly.
 - o. Other necessary identification.
5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- G. Options: Identify options requiring selection by Project Manager.
- H. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Project Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Post electronic submittals as PDF electronic files directly to Owner's FTP site specifically established for Project if needed because of file size.
 - a. Project Manager will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Submit electronic submittals via email as PDF electronic files.
 - a. Project Manager will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 3. Submittals: Submit five (5) paper copies of each submittal unless otherwise indicated. Project Manager will return one (1) copy for the Contractor's use. Contractor shall submit additional copies as needed for his use.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Owner's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.

- b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Project Manager will return submittal with options selected.
 - 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three (3) sets of Samples. Owner will retain two (2) Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Owner.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 OWNER'S ACTION

- A. Submittals: Project Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Project Manager will mark each submittal to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Project Manager.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may be returned by the Project Manager without action.

3.3 REQUIRED SUBMITTALS for the **Conservation Center Replacement (56-01-71)**:

- A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

- B. Legend:

<u>CODE</u>	<u>TYPE OF SUBMITTAL</u>
1.	Shop Drawing
2.	Product Data
3.	Sample
4.	Product Certification, Weigh Tickets
5.	Manufacturer's Instructions
6.	Test Report
7.	Field Report
8.	Wiring Diagrams
9.	Record Photographs
10.	Operation & Maintenance Data
11.	Warranty
12.	Special Measures

- | | |
|-----|---------------------------|
| 13. | Schedules |
| 14. | Special Drawings/Diagrams |
| 15. | Personnel Certifications |
| 16. | Proposals |
| 17. | Design Mixes |
| 18. | Mock-up |
| 19. | Project Record Documents |

C. List of required submittals for Conservation Center Replacement (56-01-71):

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>CODE</u>
007000	Progress Schedule	13
007000	List of subcontractors and suppliers	13
013100	Project Management and Coordination	14,15
014800	Construction Survey Staking	19
015000	Temporary Facilities and Controls	1,2,16
015639	Temporary Tree and Plant Protection	1,9,12,14
017300	Execution	2,16
017700	Closeout Procedures	2,10,11,16,19
017839	Project Record Documents	19
024118	Cutting and Patching	1,2,7,12,13,14
024119	Selective Structure Demolition	12,13,16
033000	Cast-In-Place Concrete	1,2,4,5,6,7,15,16,17
033543	Polished Concrete Finishing	1,2,3,4,5,11,12,18
042000	Unit Masonry	1,2,3,4,5,6,7,15,16,17,18
047200	Cast Stone Masonry	1,2,3,4,5,6,7,15,16,17,18
051200	Structural Steel Framing	1,2,4,5,7,12,14,15,19
053100	Steel Decking	1,2,4,5,6,7,11,15,19
054000	Cold Formed Metal Framing	1,2,4,5,6,7,11,14,15,19
055000	Metal Fabrications	1,2,4,5,6,7,11,14,15,19
057300	Decorative Metal Railings	1,2,4,5,6,7,11,14,15,19
061000	Rough Carpentry	2,4,6,12
061200	Structural Insulated Panels	1,2,4,5,6,11,14,15,19
061600	Sheathing	2,4,11,12,
061800	Glued-Laminated Construction	1,2,4,5,6,11,14,15,19
062013	Exterior Finish Carpentry	2,4,5,7,11,12,15
062023	Interior Finish Carpentry	1,2,3,4,6,11,12,14,15,
064113	Wood-Veneer-Faced Architectural Cabinets	1,2,3,4,6,11,12,14,15,
064116	Plastic Laminated Faced Architectural Cabinets and Countertops	1,2,3,4,6,11,12,14,15,
071113	Bituminous Dampproofing	2,4,
071900	Water Repellents	2,4,5,6,7,11,12,15
072100	Thermal Insulation	2,3,5,6,
072500	Weather Barriers	1,2,3,4,5,6,11,12,14,19
072610	Under-Slab Vapor Barrier	2,3,4,5,6,11,
074113	Standing Seam Metal Roof Panels	1,2,3,4,6,7,10,11,14,15,18,19

074213	Metal Plate Wall Panels	1,2,3,4,6,7,10,11,14,15,18,19
074646	Fiber-Cement Siding	1,2,3,4,6,7,10,11,14,15,18,19
076200	Sheet Metal Flashing and Trim	1,2,3,4,6,7,10,11,14,15,18
079200	Joint Sealants	1,2,3,4,6,7,10,11,14,15,18
079219	Acoustic Joint Sealants	1,2,3,4,6,7,10,11,14,15,18
081113	Hollow Metal Doors and Frames	1,2,3,4,6,10,11,14,15,18
083113	Access Doors and Frames	1,2,3,4,6,10,11,14,15,18
083323	Overhead Coiling Doors	1,2,3,4,6,10,11,14,15,18
084113	Aluminum-Framed Entrances and Storefronts	1,2,3,4,6,7,10,11,14,15,18,19
084413	Glazed Aluminum Curtain Walls	1,2,3,4,6,7,10,11,14,15,18,19
087100	Door Hardware	1,2,4,5,6,10,11,13
088000	Glazing	1,2,3,4,6,10,11,14,15,18,19
088300	Mirrors	1,2,4,5,6,10,11
092900	Gypsum Board	2,6
093000	Ceramic Tile	2,3,4,5,6,10,11,14,15
095100	Cementitious Wood Fiber Ceilings	2,3,4,5,10,11,15
095120	Acoustical Tile Ceilings	2,3,4,5,10,11,15
096513	Resilient Wall Base and Accessories	2,3
096813	Carpet Tile	2,3,4,5,6,10,11,14,15
099123	Interior Painting	2,3,4,5,6,7,10,11,14,15
099300	Staining and Transparent Finishing	2,3,4,5,6,7,10,11,14,15
099600	High-Performance Coatings	2,3,4,5,6,7,10,11,14,15
101100	Visual Display Surfaces	1,2,3,4,5,6,7,10,11,14,15
101400	Signage	1,2,3,4,5,6,7,10,11,14,15
101416	Plaques	1,2,3,4,5,6,7,10,11,14,15
101419	Dimensional Letter Signage	1,2,3,4,5,6,7,10,11,14,15
102113	Phenolic-Core Toilet Compartments	1,2,3,4,5,6,7,10,11,14,15
102239	Folding Panel Partitions	1,2,3,4,5,6,7,10,11,14,15
102800	Toilet and Bath Accessories	1,2,3,4,5,6,7,10,11,14,15
104413	Fire Protection Cabinets	1,2,4,5,6,10,11,14,15
104416	Fire Extinguishers	2,4,5,6,10,11,14,15
111313	Loading Dock Bumpers	1,2,4,5,11
115213	Projection Screens	1,2,3,4,5,6,7,10,11,14,15
122413	Roller Window Shades	1,2,3,4,5,6,7,10,11,14,15
123661	Simulated Stone Countertops	1,2,3,4,5,6,7,10,11,14,15
221500	Geothermal Well Field System	1,2
221850	Hydronic Pumps	2,5,10,11
221890	HVAC Water Treatment	2,6,10,11
223000	Fire Protection System	1,2,4,5,6,10,11,14,15
224100	Plumbing Fixtures	2,5,11
224300	Plumbing Specialties	2,5,11
224850	Water Heaters	2,5,6,10,11,15
227330	Energy Recovery Ventilators	2,5,6,10,11,15

227790	Indoor Water Source Heat Pumps (3 to 10 tons)	2,5,10,11
228200	Duct Accessories and HVAC Specialties	2,5,6,10,11,15
228350	Power Ventilators	2,5,6,10,11,15
228550	Diffusers, Registers, and Grilles	2,5,6,10,11,15
229000	Building Management System	
229500	Testing, Adjusting, and Balancing	2,5,6,10,11,13,15,19
261300	Raceways and Boxes	2,4,6,10,13,15
261400	Wiring Devices	1,2,4,5,6,7,8,10,13,14,
261450	Lighting Control Devices	1,2,3,4,5,6,10,11,12,13,14,15,
264100	Safety Switches	1,2,3,4,5,6,10,11,12,13,14,15,
264420	Panelboards	1,2,4,5,6,7,8,10,14,
265110	Lighting Fixtures	1,2,4,5,6,7,10,11,13,14,15
266100	Data and Communications	1,2,3,4,5,6,8,10,13,14,15,
269000	Fire Alarm System	1,2,4,5,6,10,11,14,15
311000	Site Clearing	1,9,12,13,16,19
312000	Earth Moving	2,3,4,5,7,9,12,
313116	Termite Control	2,4,5,6,7,10,11,12,15
321216	Asphalt Paving	2,4,6,7,15,17
321313	Concrete Paving	2,3,4,5,6,10,11,14,15
321373	Concrete Paving Joint Sealants	2,3,4,6,7,10,11,14,15
328400	Planting Irrigation	1,2,7,12,13,
329113	Soil Preparation	2,3,4,5,6,7,12,17
329200	Turf and Grasses	2,3,4,5,6,15,17
329300	Plants	2,3,4,5,6,7,9,10,11,12,17,
334100	Storm Utility Drainage Piping	2,4,5,6,7,9,19
334600	Sub-drainage	2,3,4,5,6

- D. Warranty Information shall be submitted in accordance with Section 007000 "General Conditions," Article 32 "Warranties."

3.4 REQUIRED SUBMITTALS for the **Storage Building Improvements (56-01-64)**:

- A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

- B. Legend:

<u>CODE</u>	<u>TYPE OF SUBMITTAL</u>
1.	Shop Drawing
2.	Product Data
3.	Sample
4.	Product Certification, Weigh Tickets
5.	Manufacturer's Instructions
6.	Test Report
7.	Field Report
8.	Wiring Diagrams
9.	Record Photographs

10. Operation & Maintenance Data
11. Warranty
12. Special Measures
13. Schedules
14. Special Drawings/Diagrams
15. Personnel Certifications
16. Proposals
17. Design Mixes
18. Mock-up
19. Project Record Documents

C. List of required submittals for **Storage Building Improvements (56-01-64)**:

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>CODE</u>
007000	Progress Schedule	13
007000	List of subcontractors and suppliers	13
013100	Project Management and Coordination	14,15
014800	Construction Survey Staking	19
015000	Temporary Facilities and Controls	1,2,16
015639	Temporary Tree and Plant Protection	1,9,12,14
017300	Execution	2,16
017700	Closeout Procedures	2,10,11,16,19
017839	Project Record Documents	19
024116	Structure Demolition	9,12,13,15,16
024120	Water Supply Well Abandonment	9,12,15,16
033000	Cast-in-Place Concrete	1,2,4,6,15,17
055000	Metal Fabrications	1,2,3,4,6,
061000	Rough Carpentry	2,6
061600	Sheathing	1,2,3,4,6
061760	Metal Plate Connected Wood Trusses	1,2,4,6,11,15,19
062013	Exterior Finish Carpentry	2,4,6,7
064020	Interior Architectural Woodwork	1,2,3,11,
066400	Plastic Paneling	2,3,6,11
072100	Building Insulation	2,4,6
074113	Metal Roof	1,2,3,4,6,7,10,11,14,15
074213	Metal Wall Panels	1,2,3,4,6,7,10,11,14,15
076200	Sheet Metal Flashing Trim	1,2,3,4,11,15
078413	Penetration Firestopping	1,2,4,5,6,11,15,
079200	Joint Sealants	1,2,3,4,5,11,12,15,18
081100	Steel Door and Frames	1,2,3,10,11,13,15
083613	Sectional Doors	1,2,3,10,11,13,15
085200	Wood Windows	1,2,3,4,5,6,10,11,13,15
087100	Door Hardware	1,2,4,6,10,11,13,15
092600	Gypsum Board Assemblies	2,6
096530	Resilient Wall Base Accessories	2,3
099120	Interior Painting	2,3,4,5,6,11,18

101400	Signage	1,2,3,10,11,14,15,16
105220	Fire Extinguishers, Cabinets, and Accessories	2,4,10
108010	Toilet and Bath Accessories	1,2,7,10,11,13
220410	Plumbing Piping	2,4,15
221101	Boring and Jacking	1,2,7,9,11,14,15,16, 19
221113	Facility Water Distribution	1,2,6,7,9,10,14
221313	Sewage Lines and Manholes	1,2,6,7,
224400	Plumbing Fixtures and Specialties	1,2,5,10,11
230762	Unit Heaters	2,10
230838	Power Ventilators	2,10
260500	Common Work Results for Electrical	2,5,
260519	Low Voltage Conductors and Cables	2,15
260526	Grounding and Bonding for Electrical System	1,2,4,6,10,14,15,
260533	Raceway and Boxes for Electrical Systems	2,4,6,10,13,15
260750	Voice and Data Communication	1,2,3,4,5,6,8,10,13,14,15,
262416	Panelboards	1,2,4,5,6,7,8,10,14,
262728	Wiring Devices	1,2,4,5,6,7,8,10,13,14,
262816	Enclosed Switches	1,2,3,4,5,6,10,11,12,13,14,15,
265119	LED Indoor Lighting	1,2,4,5,6,7,10,11,13,14,15
311000	Site Clearing	1,9,12,13,16,19
312000	Earth Moving	2,3,4,5,7,9,12,
329200	Turf and Grasses	2,4,7,11
330500	Common Work Results for Utilities	2,3

- D. Warranty Information shall be submitted in accordance with Section 007000 "General Conditions," Article 32 "Warranties."

END OF SECTION 013300

SECTION 014800 – CONSTRUCTION SURVEY STAKING

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides general information and defines specific requirements of the Contract regarding project layout during construction.

1.2 RESPONSIBILITY

- A. The Contractor is responsible for all labor and all materials including stakes, spikes, steel pins, templates, platforms, equipment, tools, and any other associated costs for all required project layout during construction detailed in the Contract Documents.
- B. The Contractor is responsible for providing a professional land surveyor or professional engineer who will be responsible for providing the surveying work, who is legally qualified to practice in Missouri, and who is experienced in providing construction surveying services for the kind of work described in the Contract Documents.
- C. Prior to any portion of the construction, the Contractor is responsible for clarifying any questions the Owner has concerning the survey staking.
- D. The Contractor is responsible for providing construction staking as described in the Contract Documents and Specifications and any other staking necessary for construction.
- E. The Contractor shall be responsible for maintaining and preserving all construction stakes and other markers until authorized by the Owner to remove them.
- F. The Contractor is responsible for maintaining or re-establishing original survey monuments shown on the Contract Drawings after the date of "Notice to Proceed" and throughout the duration of the Project.
- G. The Owner is responsible for providing and maintaining the survey monuments shown on the Contract Drawings before the date of "Notice to Proceed".
- H. The Contractor is responsible for all work and associated cost for correcting all work found to be out of conformance with the Plans and Specifications.

1.3 QUALITY ASSURANCE

- A. Construction of any portion of the Work shall not proceed until the Contractor has provided the necessary construction survey staking for that work portion.
- B. The Owner may require that work be suspended at any time when horizontal and vertical control points established at the site by the Contractor are not reasonably adequate to permit checking the Work. Suspensions of the Work for inadequate staking shall not be used to extend the "time for completion of the Work"; as described in Article 13 of the General Conditions.

- C. All construction staking field notes, sketches, recordings, and computations made by the Contractor in establishing control points shall be available at all times during the progress of the Work for ready examination by the Owner.
- D. The Contractor shall maintain a log of layout control work that is in accordance with standard and approved methods. At a minimum, this log:
 - 1. Shall list the names and license numbers of the professional land surveyors or professional engineers who are responsible for the work.
 - 2. Shall be available for reference by the Owner during construction.
 - 3. Shall be submitted to the Owner at the conclusion of the project.
 - 4. Record deviations from required lines and levels.
 - 5. Record beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used.
- E. Upon completion of the Work, the Contractor shall submit the log of layout control work to the Owner.
- F. If sewer and drainage structure or building construction is a portion of this Contract, prior to final payment, the Contractor shall submit a document that is signed and sealed by the responsible land surveyor or professional engineer that provides the following "As Built" information.
 - 1. Inlet and outlet invert elevations for all drainage structures.
 - 2. Finished deck or floor elevations for all buildings.
- G. The Contractor shall note any deviations from the original plans discovered by the Contractor's qualified land surveyor or professional engineer on the "As Built" Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION LAYOUT

- A. Before preceding to layout the Work, verify layout information shown on the Drawings, in relation to existing survey monuments. If discrepancies are discovered, notify the Project Manager promptly for clarification.
- B. Establish a minimum of two (2) permanent benchmarks and two (2) permanent control points to set lines and levels for each portion of construction and elsewhere as needed to locate each element of the Project.
- C. Record benchmark and control point locations, with horizontal and vertical data, within the Project Record Documents.
- D. Locate and layout clearing limits and site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- E. Locate and lay out control line and levels for structures, foundations, column grids, and floor levels, including those required for mechanical work.

- F. Level foundations and piers from two or more locations.
- G. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
- H. Inform installers of lines and levels to which they must comply.
- I. Check the location, level, and plumb of every major element as the Work progresses.
- J. Notify the Project Manager of any deviations from plan lines and levels.

END OF SECTION 014800

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Security and protection facilities include, but are not limited to the following:
 - 1. Barricades and warning signs
 - 2. Environmental protection
 - 3. Traffic control devices
- C. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's staff and representatives such as Contract Supervisor, Project Manager, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Contractor pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Contractor pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Contractor pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Trash Service: Contractor shall pay for trash service use charges for trash service used by all entities for construction operations.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of applicable permits or authorities having jurisdiction, whichever is more stringent.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Environmental Protection Regulations Standards: comply with NAPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- D. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
 - 1. Health and safety regulations
 - 2. Utility company regulations
 - 3. Police, fire department, and rescue squad rules

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.
- C. Contractor shall provide all temporary utilities and sanitation facilities. No Owner controlled facilities will be available to the Contractor.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel office activities. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Drinking water.
 - 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 4. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds or Trailers: Provide sheds or trailers sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide an adequate filter at each unit and at each return-air grille in system. Replace filters a minimum of weekly or more often if needed and remove and replace the filters at end of construction. If the Owner authorizes use of permanent HVAC system for temporary use during construction and there are concerns that the filters are not being adequately maintained, the Owner will prohibit the use of the permanent HVAC system by the Contractor and the Contractor shall be responsible for providing the temporary HVAC system as needed for performing the work.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Coordinate change in temporary utility services with previous contractor from Phase I of the construction project. If no utility services are active at the time of the "Notice to Proceed", establish new temporary services as needed.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. The Contractor shall provide an adequate supply of drinking water for his/her employees and subcontractors. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At substantial completion, restore these facilities to condition existing before initial use.

- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for project identification sign.
- H. Telephone Service: The Contractor's Superintendent shall carry a cellular telephone so that he can be reached during work hours.
 - 1. The Contractor's Superintendent shall maintain and post a list of important telephone numbers, including the following:
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Project Manager and Consultant's office.
 - f. Principal subcontractors' field and home offices.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Project Manager schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. If necessary, provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.
 2. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 3. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
 4. Recondition base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting, and testing.
 5. Delay installation of final pavement or aggregate surface courses until immediately before Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas within the project work area for or use by Contractor's construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of permits and authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings. Comply with requirements of Section 015800 "Information Sign."
 2. Maintain and touchup signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 FUEL STORAGE AND DISPENSING

- A. Contractor shall store fuel onsite only in approved locations and in containers that meet all local, state and federal regulations and comply with relevant fire codes.
- B. Contractor shall provide secondary containment and spill protection devices at all onsite fueling facilities in accordance with all applicable federal, state, and local laws and regulations' including conformance with the Contractor's Spill Prevention, Control and Countermeasure (SPCC) Plan.
- C. Extreme care shall be taken to prevent fuel spills. Contractor's representative shall be present at all times when equipment is being fueled.
- D. Contractor shall notify Contract Supervisor and other authorities as required in the event of a spill. Contractor is responsible for all mandatory regulatory notifications and reports of any releases.
- E. Contractor shall be prepared to provide personnel, equipment, and materials to immediately respond to fuel spills. Contractor is responsible for all costs in connection with removing and disposing of materials contaminated by fuel spills.
- F. Contractor shall provide and maintain absorbent materials, shovels, containers and other appropriate materials for spill response and cleanup. Cleanup materials shall be appropriate for the type of fuels, oils and other materials used.
- G. Contractor shall not commingle waste materials caused by fueling or vehicle maintenance activities with excavated soil or other materials associated with the work.
- H. Contractor shall dispose of waste materials caused by fueling at no additional expense to the Owner.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.

4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
 - E. Tree and Plant Protection: Keep construction traffic outside the drip line of trees that are to remain. Install temporary fencing located as directed by the Project Manager if needed on the outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
 - F. Pest Control: After buildings are enclosed, engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular (minimum of 6 months) intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
 - G. Site Enclosure Barrier Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 1. Extent of Fence: As required to secure the work area within the Project site or portion determined sufficient to accommodate construction operations.
 - H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
 - I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
 - J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.

3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Sections:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
 - 1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

1.5 INFORMATION SUBMITTALS

- A. Qualification Data: For qualified arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA, minimum.
- B. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Field quality control.

1.7 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
 - 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.
- B. Topsoil: Imported or manufactured topsoil complying with ASTM D 5268.
- C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 - 1. Type: Shredded hardwood, ground or shredded bark, or wood and bark chips.
 - 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.
- D. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Landscape Architect.
 - 1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart.
 - a. Height: 4 feet.
 - b. Color: High-visibility orange, nonfading.
 - 2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.
- E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 - 1. Size and Text: As shown on Drawings.
 - 2. Lettering: 3-inch- high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue-vinyl tape around each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
 - 1. Apply 4-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Landscape Architect.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Landscape Architect. Install one sign spaced approximately every 50 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Landscape Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 3120DO "Earth Moving."
- B. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.
- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition.

Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Do not paint cut root ends.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches inside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
 - a. Type of Pruning: Cleaning.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
- B. Chip removed branches and dispose of off-site.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.
 - 1. Submit details of proposed root cutting and tree and shrub repairs.
 - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 - 4. Perform repairs within 24 hours.
 - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Soil Aeration: Where directed by Landscape Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch-diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 015800 – INFORMATION SIGN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies all materials and procedures used to paint and install the information sign.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber for the information sign shall be straight, well-seasoned and free from serious defects which may materially impair the strength. The sign board shall be 4' x 8' x 5/8" exterior plywood. Posts shall be 4" x 4" square.
- B. Paint shall be high quality exterior grade paint.

PART 3 - EXECUTION

3.1 PAINTING

- A. All letters shall be block type as indicated in the Contract Drawings. Size and color of letters shall be as shown on the drawing.

3.2 PLACEMENT AND REMOVAL

- A. Information sign shall be erected at the beginning of construction at the location designated by the Project Manager and shall be removed at the time of final inspection.

END OF SECTION 015800

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 4. Section 024116 "Structure Demolition" for demolition and removal of existing bridge and existing improvements indicated to be removed.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 ACTION SUBMITTALS

- A. Qualification Data: For land surveyor and/or professional engineer used for Construction Survey Staking.
- B. Certificates: Submit certificate signed by land surveyor or professional engineer – certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List services that cutting and patching procedures will disturb or affect. List services that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Land Surveyor/Engineer Qualifications: A professional land surveyor or engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Project Manager of locations and details of cutting and await directions from Project Manager before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.
 3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Project Manager's opinion, reduce the aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use new materials for patching identical to original in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Project Manager for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Project Manager according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Project Manager promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices as per Section 14800 "Construction Survey Staking".
- C. Site Improvements: Locate and lay out site improvements, including pavements, sidewalks, ramps, structures, aggregate surfaces, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Structure Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the Project Manager and Contract Supervisor.

3.4 FIELD ENGINEERING

- A. Identification: Owner has identified existing benchmarks, control points, and similar reference points on the Drawings.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of the Project Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to the Project Manager and Contract Supervisor before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Project Manager.
 - 2. Allow for structure movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Proceed with patching after construction operations requiring cutting are complete.
- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven (7) days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in the Contract Documents.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and restore damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Warranties.
 - 3. Final cleaning.
 - 4. Repair of the Work.
- B. Related Requirements:
 - 1. Section 007000 "General Conditions" for substantial completion and warranties.
 - 2. Section 017300 "Execution" for progress cleaning of Project site.
 - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. General: Contractor shall comply with Section 007000 "General Conditions," Article 14 and Article 28.
 - 1. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Procedures Prior to Substantial Completion: Complete the following a minimum of ten (10) days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents bound in binder.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

4. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Complete final cleaning requirements, including touchup painting.
 11. Advise Owner of change over in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of five (5) days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Project Manager will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Owner, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 007000 "General Conditions."
 2. Certified List of Incomplete Items: Submit certified copy of Project Manager's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Project Manager. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Project Manager will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order.
 - 2. Organize items applying to each space by major element, including categories for different components.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Contractor.
 - d. Page number.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Project Manager for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep pavement and bridge deck broom clean.
 - h. Remove labels that are not permanent.
 - i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - j. Replace parts subject to unusual operating conditions.
 - k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - l. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - m. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - n. Leave Project clean and ready for occupancy.
- B. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification. Remove paint applied to required labels and identification.
 2. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 007000 "General Conditions" for general requirements for project record documents.
 - 2. Section 014800 "Construction Survey Staking" for log of layout control work.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.

- d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
- 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Locations of concealed internal utilities.
 - i. Changes made by Change Order or Construction Change Directive.
 - j. Changes made following Project Manager's written orders.
 - k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
 - m. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Project Manager and Consultant.
 - e. Name of Contractor.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file or paper copy.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Project Manager's reference during normal working hours.

END OF SECTION 017839

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PROJECT MANUAL
Volume 2 of 3

SHEPHERD OF THE HILLS FISH HATCHERY

CONSERVATION CENTER REPLACEMENT

PROJECT JOB NUMBER: 56-01-71

AND

STORAGE BUILDING IMPROVEMENTS

PROJECT JOB NUMBER: 56-01-64

TANEY COUNTY, MISSOURI

Designed by:

Missouri Department of Conservation
Design and Development

Bid Date:

January 26, 2017

**MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT**
2901 WEST TRUMAN BLVD., PO BOX 180
JEFFERSON CITY, MISSOURI 65102



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SECTION 024118 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied

spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 024118

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SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Pre-Demolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.5 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Review Project Record Documents of existing construction or other existing conditions and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Architect.
- F. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Arrange to shut off indicated utilities with utility companies and Owner.
 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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15SECTION - 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, form facings, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.
 - 3. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.
- C. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- D. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For steel reinforcement and formwork.
 - 1. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - 2. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.

- E. Samples for Verification: Architectural Concrete Finish Samples, to be used to judge finished work in place, approximately 12 by 12 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1. Samples: For each of the following materials:

- a. Form-facing panels.
- b. Form ties.
- c. Form liners.
- d. Exposed aggregates.
- e. Coarse- and fine-aggregate gradations.
- f. Chamfers and rustications.

- F. Material test reports.

- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

1.5 QUALITY ASSURANCE

- A. General: It is the goal of this project to produce concrete of the highest possible standard. The concrete shall have sharp, straight corners; good definition of details, and flat, smooth surfaces, unblemished and of consistent color. Normal industry standards for formwork fabrication and installation will be exceeded to meet this goal.

- B. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

- D. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

- G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301 (2008), "Specifications for Structural Concrete," Sections 1 through 5.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- I. Field Sample Panels for Exposed Aggregate Slabs: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.
1. Locate panels as indicated or, if not indicated, as directed by Architect.
 2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
 3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove field sample panels when directed.
- J. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. Before casting the mock-up, submit full detailed Shop Drawings of the mock-up formwork for review by the Architect. Perform all necessary preliminary tests to ensure that concrete used for the mock-up will exactly match the approved sample in color and texture.
 3. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
 - a. Build panel approximately 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
 - b. In- Place Mock-up: Select a vertical location of concrete to be covered by other work to perform mock-up. Do not proceed with installation of concrete to receive architectural or exposed finish until mock-up is approved
 4. Build mockups of typical cast concrete slab-on-grade panels of cast-in-place architectural concrete as shown on Drawings.
 - a. Build panel approximately 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
 5. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
 6. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 7. The completed mock-up shall be inspected and approved by the Architect. Failure of the mock-up to match the approved sample will require the construction of further mock-ups until approval is obtained. Remove rejected mock-ups immediately
 8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Pre-installation Conference: Conduct conference at Project site.
- L. Stain Preventions: Prevent staining of exposed concrete from all potential staining agents including soil.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301.
 - 2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.
- B. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- C. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Form Liners: Units of face design, texture, arrangement, and configuration **indicated**. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
- F. Chamfer Strips: rubber strips, 1/2 by 1/2 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.
- I. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.
- J. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- K. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- L. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
- M. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II, gray. [Supplement with the following:]
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Normal-Weight Aggregates for Exposed Aggregate Concrete: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from single source **with documented service-record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.**
 - 1. Maximum Coarse-Aggregate Size: **3/4 inch**
 - 2. Gradation: **Uniformly** graded.

- E. Normal-Weight Fine Aggregate for Exposed Aggregate Concrete: **ASTM C 33/C 33M** manufactured or natural sand, from same source for entire Project.
- F. Water: **ASTM C 94/C 94M** and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: **ASTM C 260**.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: **ASTM C 494/C 494M, Type A**.
 - 2. Retarding Admixture: **ASTM C 494/C 494M, Type B**.
 - 3. Water-Reducing and Retarding Admixture: **ASTM C 494/C 494M, Type D**.
 - 4. High-Range, Water-Reducing Admixture: **ASTM C 494/C 494M, Type F**.
 - 5. High-Range, Water-Reducing and Retarding Admixture: **ASTM C 494/C 494M, Type G**.
 - 6. Plasticizing and Retarding Admixture: **ASTM C 1017/C 1017M, Type II**.

2.7 WATERSTOPS

- A. Flexible PVC Waterstops: **CE CRD-C 572**, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BoMetals, Inc.
 - b. Greenstreak.
 - c. Paul Murphy Plastics Company.
 - d. Vinylex Corp.
 - 2. Profile: Ribbed with center bulb.
 - 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: **ASTM E 1745, Class A**. Include manufacturer's recommended adhesive or pressure-sensitive tape. Slab-on-grade in basement area shall receive under-slab vapor barrier per section 072610.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Meadows, W. R., Inc.; Perminator 15 mil.
 - c. Stego Industries, LLC; Stego Wrap 15 mil Class A.
 - 8. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; **ASTM D 448, Size 57**, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.9 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- C. Cementitious Materials:
1. Fly Ash: 15 percent
 2. Combined Fly Ash and Pozzolan: 15 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Minimum Cementitious Materials Content: 520 lb/cu. yd. .
 3. Slump Limit: 4 inches , plus or minus 1 inch .
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
- D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Minimum Cementitious Materials Content: 520 lb/cu. yd. .
 3. Slump Limit: 4 inches , plus or minus 1 inch .
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
- E. Building Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: D.45.
 3. Slump Limit: 4 inches , plus or minus 1 inch .
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 2. When air temperature is between 85 and 90 deg F , reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.

3. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
 - G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
 - H. Chamfer, as indicated on drawings, exterior corners and edges of permanently exposed concrete.
 - I. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
 - J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
 - K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
 - L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
 - M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
 - N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 1. Schedule form removal to maintain surface appearance that matches approved field sample panels and mockups.
 2. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHES, GENERAL

- A. Architectural Exposed Concrete Finish: Match Architect's design reference sample, mockup, or field sample panels, identified and described as indicated, to satisfaction of Architect.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects as indicated. Remove fins and other projections that exceed specified limits on formed-surface irregularities as indicated. Verify extent and method of defect repairs with Architect prior to repair.

1. Apply to concrete surfaces exposed to public view.
 2. Architectural Concrete Finish: Where concrete vertical surfaces are to be exposed to view and where noted, match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect. Do not parge coat surface or apply any grout to the face of walls. Use clean formwork, vibrate and consolidate as necessary to eliminate honeycombing. Strip forms and remove excess concrete and burrs only. Review any voids and surface pops with architect prior to adding any grout. Walls must be kept clean and protected through out construction from any permanent marks from red clay, red chalk and any other permanently disfiguring or discoloring substances. Concrete that cannot be cleaned to Owner and Architect's approval shall be patched, repaired or replaced.
- C. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. **Float Finish:** Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated.
 2. Concrete floor slabs noted to be sealed (Floor Finish Type FF4) shall receive Consolideck LSGuard or equal at time of initial pour and a secondary coat of LS Guard or equal [at time of floor grind and polishing]. Provide final burnishing pass.
- C. **Trowel Finish:** After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155 , for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch .
- D. **Broom Finish:** Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- E. **Slip-Resistive Finish:** Before final floating, apply slip-resistive aggregate, finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.

3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.12 EXPOSED-AGGREGATE FINISHES

- A. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed. Rinse scrubbed surfaces with clean water. Maintain continuity of finish on each surface or area of Work. Remove only enough concrete mortar from surfaces to match design reference sample or mockup.
- B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
 1. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.
- C. Abrasive-Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.
 1. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample or mockup.
 2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
 3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:
 - a. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
 - b. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch.
 - c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/4 inch.
 - d. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 1/2 inch.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Begin curing cast-in-place architectural concrete immediately after removing forms from or applying as-cast formed finishes to concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENTS

- A. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 - 1. Machine grind floor surfaces to receive polished finishes level and smooth.

2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written

instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.18 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. , but less than 25 cu. yd. , plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.19 REPAIR, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

3.20 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes polished concrete finishing.
 - 1. Mechanical grinding and polishing of horizontal concrete floors.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.2 REFERENCES

- A. ASTM C 1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile or Other Like Surfaces by the Horizontal Dynamometer Pull Meter Test.
- B. ASTM D 3278 Standard Test Method for Flash Point of Liquids by Small Scale Closed Cup Apparatus.
- C. ASTM D 3363-05 Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM E 430 Standard Test Method for Measurement of Gloss of High-Gloss Surfaces by Abridged Goniophotometry.
- E. Rilem Test Method -Test No. 11.4 Measurement of Water Absorption Under Low Pressure.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets on all products to be used for the work. Submit description for protection of surrounding areas, surface preparation, application, and final cleaning.
- B. Verification Samples: Provide manufacturer's color chart.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors.
- D. Verification Samples: For each finish product specified, two samples, minimum size 12 inches square, representing actual product, color, and finish.
- E. Shop Drawings: Indicate information on shop drawings as follows:
 - 1. Typical layout including dimensions and floor grinding schedule.
 - 2. Plan view of floor and joint pattern layout.
 - 3. Areas to receive colored surface treatment.
 - 4. Hardener, sealer, densifier in notes.
- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- G. Manufacturer's acknowledgement of applicator qualifications.
- H. VOC Certification: Submit certification that products furnished comply with regulations controlling use of volatile organic compounds (VOC).
- I. Process Modifications: Ten business days prior to commencement of application contractor may submit for review modifications to steps specified to obtain architects and manufacturer approval before proceeding.

1.4 PERFORMANCE GUIDELINES

- A. Testing Criteria: High tolerance hardened concrete floor finish shall comply with the following performance requirements.
 - 1. Performance Characteristics:
 - a. ADA Coefficient of Friction: Meets or exceeds ADA COF of 0.60 for accessible routes and 0.80 for ramps tested in accordance with ASTM C 1028.
 - b. Degree of Reflectiveness as per horizontal test area tested in accordance with ASTM E 430. Increase of 35% as determined by standard gloss meter
 - c. Degree of Hardness as per horizontal test area tested in accordance with ASTM D 3363-D5.
 - d. Measure of Water Absorption as per horizontal test area tested in accordance with Rilem Test Method - Test No. 11.4 - 70% or greater reduction in absorption.
- B. Appearance Expectations:
 - 1. Aesthetics:
 - a. Aggregate Exposure: **Class B - Salt/Pepper Finish.** Expose the fine aggregate such as sand and small aggregate with the concrete. The depth of grind will depend greatly on the placement and finishing procedures. Generally, this level of cut can be achieved within 1/16" of the surface. **Exposure of coarse aggregate must be approved by the Architect based on the Test Area.**
 - b. Color: Uniform and even as approved in Test Area.
 - 2. Quantitative
 - a. Gloss Level: **Level 3 Sheen [semi-gloss]** as determined by a gloss reading of 50-60.
 - b. Mohs Hardness: 5.5+
 - c. Slip Resistance: 0.60
 - d. Water Resistance: maintain level for 20 minutes

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications:
 - 1. Installer specializing in performing work of this section, trained by the liquid hardener manufacturer, with a minimum of **5 years** experience in performing work of this section who has specialized in installation of work similar to that required for this project
 - 2. Employs persons trained for the application of the specified products
- B. Pre-Construction Meeting: Conduct a pre-construction meeting before the start of work on new concrete slabs, patching of existing concrete slabs and start of application of concrete finish system. Require attendance of parties directly affecting work of this Section, including the Contractor, Architect, concrete installer, finish applicator, and manufacturer's representative. Review environmental regulations, test area procedures, protection of surrounding areas, surface preparation, application, field quality control, final cleaning, and coordination with other work. Verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:
 - 1. Physical requirements of completed concrete slab and slab finish.
 - 2. Locations and schedule of test areas.
 - 3. Environmental requirements.
 - 4. Scheduling and phasing of work.
 - 5. Coordinating with other work and personnel. Remind all trades that they are working on a surface that is to become a finished surface.
 - 6. Protection of adjacent surfaces.
 - 7. Surface preparation.
 - 8. Repair of defects and defective work prior to installation.
 - 9. Quality Control.
 - 10. Cleaning.
 - 11. Installation of polished floor finishes.

12. Application of liquid hardener, densifier.
 13. Protection of finished surfaces after installation.
 14. Do not place any materials on the concrete surface that may cause staining, etching or scratching.
 15. Removal of concrete waste slurry.
- C. Performance Test Area: Provide a test area for evaluation of slab placement, surface preparation, control and expansion joints, high tolerance floor finish application workmanship, color, sheen, slip resistance and water resistance.
1. Provide test area for each finish specified.
 2. Review manufacturer's product data sheets to determine the suitability of each product for the specified surface.
 3. Apply as stated under Execution in this specification. Any variation from the specification must be approved by the Architect.
 4. Test area shall be a minimum of 100 square feet or 1 percent of horizontal surface to be constructed and treated in location designated by Architect.
 - a. Test area will comply with 1.4 "Performance Guidelines".
 5. Do not proceed with remaining work until approved by Architect.
 6. Maintain approved test area during construction in an undisturbed condition standard for judging the complete work.
 7. Approved test areas may become a part of the completed work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling:
1. Store containers upright in a cool, dry, well, ventilated place, out of the sun with temperature between 40 and 100 degrees F (4 and 38 degrees C).
 2. Protect from freezing.
 3. Store away from all other chemicals and potential sources contamination.
 4. Keep lights, fire, sparks and heat away from containers.
 5. Do not drop containers or slide across sharp objects.
 6. Do not stack pallets more than three high.
 7. Keep containers tightly closed when not in use.
 8. Store and handle materials in accordance with manufacturer's written instructions.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.

1.8 PROJECT CONDITIONS

- A. Temperature Limitations:
1. Do not apply when surface and air temperature are below 40 degrees F or above 95 degrees F unless otherwise indicated by manufacturer's written instructions.
 2. Do not apply when surface and air temperatures are not expected to remain above 40 degrees F for a minimum of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.
- B. Do not apply under windy conditions such that the concrete surface treatment may be blown to surfaces not intended.

- C. Do not apply to frozen substrate. Allow adequate time for substrate to thaw, if freezing conditions exist before application.
- D. Do not apply earlier than 24 hours after rain or if rain is predicted for a period of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.
- E. Temporary Lighting: Minimum 200 W light source, placed 8 feet (2.5 m) above horizontal concrete surface, for each 425 square feet (40 sq m) of concrete being finished.
- F. Temporary Heat: Ambient temperature of 50 degrees F (10 degrees C) minimum.
- G. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.

1.9 COORDINATION

- A. Coordinate the work with concrete placement, initial finishing and concrete curing.

PART 2 - PRODUCTS

2.1 POLISH CONCRETE FINISHING PRODUCTS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. L&M Construction Chemicals, Inc.
 - 2. PROSOCCO, Inc.

2.2 LIQUID HARDENERS

- A. Description: Hardener, Sealer, Densifier, water based, odorless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film.
 - 1. Properties:
 - a. Form: Clear, water-like liquid
 - b. Specific Gravity: 1.10
 - c. pH: 11.
 - d. Wt/Gal: 9.2 lbs.
 - e. Active Content: 14.5 percent
 - f. Total Solids: 14.5 percent
 - g. Freeze Point: 32 degrees F (0 degrees C)
 - h. VOC Content: less than 20 g/L

2.4 PROTECTIVE TREATMENTS

- A. Description: High-gloss penetrating premium sealer, lithium silicate hardener for horizontal concrete surfaces including cement terrazzo. Treated surfaces resist damage from water, chemical attack and abrasion.
 - 1. Properties:
 - a. Form: Milky white liquid
 - b. Specific Gravity: 1.11
 - c. Active Content: 22 percent
 - d. Total Solids: 22 percent
 - e. pH: 11.0
 - f. Wt/Gal: 9.2 lbs.
 - g. Freeze Point: 32 degrees F (0 degrees C)
 - h. VOC Content: Less than 100 g/L

2.5 MAINTENANCE CLEANING PRODUCTS

- A. Description: A concentrated maintenance cleaner for concrete floors with lithium silicate component to help maintain concrete hardness by curing any "soft" calcium hydroxide left over from the original hardening-densifying treatment.. Biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI).
 - 1. Properties:
 - a. Form: clear liquid, soapy odor
 - b. Specific Gravity: 1.00
 - c. pH: 9.87
 - d. Wt/Gal: 8.38 lbs.
 - e. Flash Point: ASTM D 3278, more than 200 degrees F (more than 93 degrees C)
 - f. VOC Content: Maximum 4 percent

2.6 BURNISHING EQUIPMENT

- A. High speed burnisher manufacturer.

2.7 ADDITIONAL EQUIPMENT

- A. Pump sprayer and tip.
 - 1. Pump compatible for solvent for SLX100
 - 2. Pump compatible for water based material
 - 3. Tip size not to exceed 0.5 GPM
- B. Airless.
 - 1. Produces 0.47 GPM, equivalent to GRACO 390 with 4 or 611 tip and Extended Reach Tools.
- C. Microfiber mop with wet pads
- D. Soft bristle broom

2.8 ENVIRONMENTAL EQUIPMENT

- A. Applicator is to submit Environmental Plan in accordance with local regulatory requirements. Permits or notice from local regulatory accepting and acknowledging method of disposal of waste.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- B. Verify by examination that concrete surfaces are acceptable to receive the specified products. Notify the Architect if surfaces are not acceptable to receive the specified products.
- C. Any changes that need to be made to the procedures are to be processed through the submittal process and not to be executed till approved.

3.2 PREPARATION

- A. Clean dirt, dust, oil, grease and other contaminants from surfaces that interfere with penetration or performance of specified product. Use appropriate concrete cleaners approved by the concrete

surface treatment manufacturer where necessary. Rinse thoroughly using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of product.

- B. Utilize appropriate Surface Preparation Cleaner products as dictated by conditions found onsite.
- C. Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by the Architect. Allow repair materials to cure completely before application of product.
 - 1. Install epoxy grout to repair damaged areas (spalling, pits, construction damage, etc.).
- D. Variations in substrate texture and color will affect final appearance and should be corrected prior to application of sealer/hardener system and the polishing steps.
- E. Protect surrounding areas prior to application. If accidentally misapplied to adjacent surfaces, flush with water immediately before material dries.
- F. Avoid contact in areas not to be treated. Avoid contact with metal, glass and painted surfaces.
- G. Apply specified Control Joint Filler.
- H. After floor has been finished apply specified sealants to isolation and expansion joints

3.2 APPLICATION - GRINDING STEP

- A. Surface is to be opened to receive liquid hardener. Test floor for hardness to determine beginning point. Select appropriate grinding level to begin and grind surface to achieve uniform even finish with minimal exposure of large aggregate.
 - 1. Grind in perpendicular directions for each step.
 - 2. Clean surface with vacuum system or auto-scrubber between each step.
 - 3. Do not overlap grind paths.
 - 4. Do not exceed double the level of the previous step.
 - 5. If using metal bonds, drop back one level down to resin.
 - 6. Bring surface to 200 resin level
 - 7. Use an auto-scrubber to remove all dust and debris from surface prior to application of liquid hardener.

3.4 APPLICATION - LIQUID HARDENER STEP

- A. Allow surface to completely dry before application of liquid hardener.
- B. Surface needs to be cleaned before application of liquid hardener.
- C. Apply liquid hardener to substrates in accordance with manufacturer's instructions, and application procedures.
 - 1. Do not dilute or alter products. Apply as packaged.
 - 2. Do not apply to painted surfaces.
 - 3. Avoid overspray, wind drift and splash of all products.
 - 4. Apply in uniform even pattern by low-pressure spray or airless.
 - 5. For low pressure spray utilize 0.5 GPM tip.
 - 6. For airless spray equipment should be a 0.47 GPM sprayer, similar to a GRACO 390 with a 611 or similar sized tip.
 - 7. Application is to be even across the surface leaving film. If material beads on surface use a soft bristle broom and lightly drag across material breaking surface tension to allow material to flow out on surface.
 - 8. If "bird baths" or low areas reveal excess liquid hardener standing, while wet move material to other areas of floor with a soft bristle broom, microfiber pad. Try not to let material pond on surface.

9. Excess material will dry on the surface and needs to be removed by brush, broom, vacuum, auto-scrubber, etc.
10. Allow material to dry and react, which should occur in the first 10-15 minutes.
11. Normal coverage rate is estimated to be 400 - 500 square feet on surfaces brought to 200 grit level. Reaction is dependent on calcium hydroxide exposure on surface of concrete.

3.5 APPLICATION - POLISHING STEP

- A. Allow area to be surface dry, approximately 30 - 60 minutes
- B. Polish concrete surface with resin diamonds in progressive levels to one level below final level when additional polishing is to be done after the Color Treatment Step.
- C. Polish each diamond level with two perpendicular passes.
- D. After each pass auto-scrub surface to remove dust and dirt.

3.6 APPLICATION - PROTECTIVE TREATMENT STEP

- A. Apply products to substrates in accordance with manufacturer's instructions, and application procedures.
- B. Apply to clean, dry, cured and properly prepared surfaces approved by the Architect.
- C. Do not dilute or alter products. Apply as packaged.
- D. Apply protective treatments @ 1,000 - 1,500 sq. ft. per gallon. Application by low pressure spray pump with a 0.5 GPM tip is recommended utilizing a premoistened microfiber pad as a spreader to pull material out in a thin film. Do not be concerned about complete coverage by spray as you pull material out you will gain uniform coverage.
- E. If material absorbs into surface too fast and leaves applicator lines dilute material 1:1 with clear potable water. Apply in the same manner as above at a rate of 500 - 750 square feet per gallon.
- F. After, material has dried, burnish with a high-speed propane burnisher (3,000 rpm) with Norton Abrasive pad either 2-4 to set protective treatment. Temperature immediately behind burnisher must be a minimum of 90.5°F. Run burnisher in two perpendicular passes to insure complete coverage.
- G. Avoid overspray, wind drift and splash of all products.
- H. If desired a second or third coat may be applied as stated above. Burnishing between coats is required.

3.7 FIELD QUALITY CONTROL

- A. Inspection: Inspect the application of the products with the Contractor, Architect, applicator and manufacturer's representative, and compare with test area results approved by the Architect.
- B. Upon completion of the project the test area is to be divided into four quadrants with five test determination per quadrant shall be taken and recorded. A minimum of ten determinations are required on all projects regardless of size.

3.8 TOLERANCES

- A. Allowable differences from "test area standards":
 1. Gloss = less than 10 percent
 2. Hardness = less than 10 percent
 3. Slip Resistance = more than 0.60 (as defined by ADA Title III, 1992)

4. Rilem Tube = less than 1 ml loss

3.9 FINAL CLEANING

- A. Clean site of all unused product, residues, rinse water, wastes, and effluents in accordance with environmental regulations.
- B. Remove and dispose of all materials used to protect surrounding areas following completion of the work of this section.
- C. Repair, restore or replace to the satisfaction of the Architect, all surfaces damaged by exposure to the work of this section.
- D. Run auto-scrubber over surface with cleaning product diluted 4 oz. to one gallon of water.
- E. Over entire surface run high-speed burnisher with appropriate Norton Abrasive pad. If areas have blemishes or scuff marks use a 1:1 diluted solution of protective treatment sprayed in front of burnisher. Confirm temperature as above.

3.10 PROTECTION

- A. General Contractor is to protect surfaces with applied products until completion of project.
- B. Do not permit traffic over unprotected floor surfaces.
- C. Touch-up repair or replace damaged products before Substantial Completion.

END OF SECTION 033543

SECTION - 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMUs).
2. Decorative Calcium Silicate masonry units (for veneer).
3. Firebox brick.
4. Mortar and grout.
5. Reinforcing steel.
6. Masonry joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.
10. Anchored Masonry Veneer.
11. Cavity-wall insulation.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Section 047200 "Cast Stone" for stone trim and wall caps.
3. Section 071900 "Water Repellents" for water repellents applied to unit masonry.
4. Section 072100 "Thermal Insulation" for cavity wall insulation.
5. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

- A. CMU(s):** Concrete masonry unit(s).
- B. Reinforced Masonry:** Masonry containing reinforcing steel in grouted cells.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.**
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.4 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.
- B. Shop Drawings:** For the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
1. Decorative Calcium Silicate Manufactured Stone.
 2. Special brick shapes.
 3. Colored mortar.
 4. Weep holes and vents.
 5. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include data on material properties.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing per ASTM C 67.
 - e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Mortar admixtures.
 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 5. Grout mixes. Include description of type and proportions of ingredients.
 6. Reinforcing bars.
 7. Joint reinforcement.
 8. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area.
 - 2. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 60 inches high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
 - b. Include lower corner of window opening framed with stone trim at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include metal studs, sheathing, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
 - 3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
 - 4. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 - 5. Protect accepted mockups from the elements with weather-resistant membrane.
 - 6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 - 7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location (minimum 3" for calcium silicate masonry units). If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Place polyethylene or other plastic film between wood and other finished surfaces of calcium silicate masonry units when stored for extended periods of time.
- C. Deliver calcium silicate masonry units in protective film. Prevent damage to units.
- D. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.
- E. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

- F. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- G. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- H. Store masonry accessories, including metal items, to prevent damage, staining, corrosion and accumulation of dirt and oil.
- I. Do not use salt or calcium-chloride to remove ice from masonry surfaces.

1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
 - 2. Density Classification: Lightweight at locations above grade and not exposed to weather, and normal weight at locations exposed to weather and below grade.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 CALCIUM SILICATE MANUFACTURED STONE MASONRY

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring units of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Manufacturers:
 - 1. Renaissance Masonry Units by Ariscraft International or Equal
- C. Materials:
 - 1. Calcium Silicate Masonry Units (Georgia): to ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; 3-5/8" bed depth; special shapes as indicated; and as follows:
 - a. Modular Size (Actual Dimensions): 3-5/8" high, 23-5/8" long
 - b. Texture: rocked) finish on exposed faces and as indicated on drawings at special conditions and exposed ends; Also provide smooth face units of same color where other work shall be mounted to face of unit (electrical devices, etc...).
 - c. Color: Sunset color; integrally colored, color per wall finish types and building sections and elevations.

2. Calcium Silicate Masonry Units (Georgia): to ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; 3-5/8" bed depth; special shapes as indicated; and as follows:
 - a. Modular Size (Actual Dimensions): 3-5/8" high, 23-5/8" long
 - b. Texture: rocked] finish on exposed faces and as indicated on drawings at special conditions and exposed ends; Also provide smooth face units of same color where other work shall be mounted to face of unit (electrical devices, etc...).
 - c. Color: Cafe color; integrally colored, color per wall finish types and building sections and elevations.
 3. Calcium Silicate Masonry Units (Georgia): to ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; 3-5/8" bed depth; special shapes as indicated; and as follows:
 - a. Modular Size (Actual Dimensions): 3-5/8" high, 23-5/8" long
 - b. Texture: rocked] finish on exposed faces and as indicated on drawings at special conditions and exposed ends; Also provide smooth face units of same color where other work shall be mounted to face of unit (electrical devices, etc...).
 - c. Color: Limestone color; integrally colored, color per wall finish types and building sections and elevations.
- D. Fabricate calcium silicate masonry units to the following tolerances:
1. Unit Length: plus or minus 1/16".
 2. Unit Height: plus or minus 1/16".
 3. Deviation From Square: plus or minus 1/16", with measurement taken using the longest edge as the base.
 4. Bed Depth: plus or minus 1/8".
 5. Custom Unit Dimensions: plus or minus 1/8".

2.5 FIREPLACE AND CHIMNEY LINING UNITS

- A. Firebox Brick: ASTM C 1261, size required to produce lining thickness indicated.
 1. Color and Size: as indicated
- B. Clay Flue Lining Units: ASTM C 315.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 15D, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
- G. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 3. Wire Size for Side Rods: 0.187-inch diameter.
 4. Wire Size for Cross Rods: 0.187-inch diameter.
 5. Wire Size for Veneer Ties: 0.187-inch diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
- D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 2 side rods at each wythe of masonry 4 inches wide or less.
 2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
 3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.
 - a. Use where facing wythe is of different material than backup wythe.
- E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized, carbon-steel continuous wire.

2.8 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel wire.
- C. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 2. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch-diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. Anchor type and attachment to comply with S.I.P. manufacturer recommendations. Attachment to meet substrate pull-out requirements and veneer load requirements.

- b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
 - c. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 9 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
 - d. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
 - e. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
 - f. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing.
4. Slip-in, Masonry-Veneer Anchors: Units consisting of a wire tie section and an anchor section designed to interlock with metal studs and be slipped into place as sheathing is installed.
- a. Wire-Type Anchor: Bent wire anchor section with an eye to receive the wire tie. Wire tie has a vertical leg that slips into the eye of anchor section and allows vertical adjustment. Both sections are made from 3/16-inch, hot-dip galvanized wire.
5. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 (4.8-mm) diameter by length required to penetrate steel stud flange with not less than 3 exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
7. **For Veneer over Concrete Backup Wall:** Flexible Ties (rated for provided airspace, spaced at 16" on center vertically and 24" on center horizontally) with continuous 9 GA. Wire embedded in veneer joints and S.I.S. type clips. See Wall Type sheet and Structural General Notes sheet.

2.9 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C, of dimensions indicated.
- C. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
 - 3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.10 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Provide as indicated in drawings.
 2. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
 3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 6. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
 7. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 8. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.
 9. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing: Use the following unless otherwise indicated:
1. Self-adhering flexible flashing: Polyester Scrim Reinforced composite flashing product consisting of a polyester-reinforced Elvaloy KEE Thermoplastic flexible membrane that has a pressure-sensitive, clear adhesive that will not drool when exposed to UV or heat.
 - a. Flex-Flash Flashing by Hohmann & Barnard, Inc. or equal.
 2. Properties:
 - a. Self-Adhesive Sheet: 0.040 inch (40 mil.) thick.
 - b. Tensile Strength: 2000 psi (14 MPa) per ASTM D 412.
 - c. Ultimate Elongation: 25 percent.
 - d. Shore A Hardness: 83 per ASTM D 2240.
 - e. Corners and End Dams: Preformed.
 3. Accessories: Provide primer, sealant, stainless steel termination bars, preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 4. Apply to clean, dry surfaces.
 5. Extend flashing beyond the wall face and cut flush with the outside face of veneer. A drip edge is not required.
 6. Install per manufacturer's recommendations. Verify compatibility with insulation materials and weather barriers prior to installation.
 7. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use flexible flashing trimmed to the face of the wall.
 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

- E. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- G. Termination Bars for Flexible Flashing: Stainless steel bars 1/8 inch by 1 inch.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
- E. Cavity Drainage Material: Install in cavity wall at all thru wall flashing / weep locations. Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Products: Subject to compliance with requirements,
 - a. Advanced Building Products Inc.; Mortar Break.
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.
 - 2. Provide one of the following configurations:
 - a. Trapezoidal shaped Mortar Net with Insect Barrier MN 10-2: 10" high x 2" thick material that prevent clogging with mortar droppings.

2.12 CAVITY-WALL INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.13 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.14 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. For exterior masonry, use portland cement-lime mortar.
 4. For reinforced masonry, use portland cement-lime mortar.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M (2500 psi). (Common mix proportion: 1 cement : 1/4 lime : 3 1/2 sand).
 2. For reinforced masonry, use Type S (1800 psi). (Common mix proportion: 1 cement : 1/2 lime : 4 1/2 sand).
 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N (750 psi). (Common mix proportion: 1 cement : 1 lime : 6 sand).
- D. Pigmented Mortar: Use colored cement product (or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products).
1. Pigments shall not exceed 10 percent of portland cement by weight.
 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 3. Mix to match Architect's sample.
 4. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative Calcium Silicate Stone Units.
 - b. Cast-stone units.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify site conditions are ready to receive work.
 3. Inspect materials for fit and finish prior to installation. Do not set unacceptable units.
 4. Verify that foundations are within tolerances specified.
 5. Verify that reinforcing dowels are properly placed.
 6. Verify that substrates are free of substances that impair mortar bond.
 7. Beginning of installation means acceptance of existing conditions.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Cutting of calcium silicate manufactured stone masonry:
1. Cut masonry units with wet-saw.
 2. Pre-soak units using clean water prior to cutting.
 3. Clean cut units using a stiff fibre brush and clean water. Allow units to surface dry prior to placement.
 4. Finish cut edges to match face when exposed in wall unless noted otherwise.
- H. Wetting of calcium silicate manufactured stone masonry:
1. Where the ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph, pre-wet masonry units.
 2. Lay wetted units when surface dry.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units (calcium silicate manufactured stone) with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Butter corner of joints. Do not deeply furrow bed joints or slush head joints.
1. Fully bond intersections and external corners.
 2. Do not adjust masonry units after laying. Where resetting of masonry is required, remove, clean units, and reset in new mortar.
 3. Install loose steel lintels as scheduled. Set angle back from face of block 1/2 inch and cut unit to fit around leg of angle. Angle shall not be visible on face of wall.
- C. Set firebox brick in full bed of refractory mortar with full head joints. Form joints by buttering both surfaces of adjoining brick and sliding it into place. Make joints just wide enough to accommodate variations in size of brick, approximately 1/8 inch. Tool joints smooth on surfaces exposed to fire or smoke.
- D. Set stone and cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
 3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 12 inches clear horizontally and 16 inches clear vertically.
- B. Bond wythes of composite masonry together using bonding system indicated on Drawings.
- C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
 - 1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
 - 1. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

3.7 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
 - c. Where one wythe is of clay masonry or calcium silicate and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
 - 3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 12 inches clear horizontally and 16 inches clear vertically.
 - 4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity. Point the cavity face of block walls and remove any excess mortar from veneer ties where noted to receive damp-proofing weather barrier.
- D. Apply weather barrier to face of backup wythe or wall substrate to comply with Division Seven "Thermal and Moisture Protection."
- E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener. Attach anchors to S.I.P. walls per S.I.P. manufacturers recommendations.
 2. Embed tie sections or connector sections and continuous wire in in masonry joints.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches around perimeter.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing and not less than 1 inch of airspace between back of masonry veneer and face of insulation.
1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.9 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches .
1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.11 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 3. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional

anchors within 12 inches of openings and at intervals, not exceeding 36 inches , around perimeter.

3.12 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick and calcium silicate manufactured stone as follows:
 - 1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch .
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.
- E. Form expansion joints in calcium silicate manufactured stone units as follows:
 - 1. As indicated on drawings.
 - 2. Refer to Arriscraft NOTE Volume I, No. 1, Building Movement Joints.
 - 3. Movement /expansion joints shall be constructed as "*elastic*" joints, accommodating both expansion and contraction of the veneer materials.
 - 4. Movement joints should typically be placed:
 - a. At changes in wall direction.
 - b. At changes in building height.
 - c. At wall openings.
 - d. At major changes in wall thickness.
 - e. At periodic lengths of continuous wall up to a maximum of 30 feet on center.
 - f. At abutments to existing structures.
 - g. Below shelf angles.

3.13 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.14 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. [Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.]
 - 1. At base of walls, capping fully grouted air cavity just above grade.
 - 2. Wall openings.
 - 3. Interruptions in the air space of a continuous cavity wall.
 - 4. At top of walls below copings and caps.
- B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
 3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
 4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 5. Install flexible flashing at exterior face of wall at head conditions. Cut flush with outside face of wall.
 6. Install metal flashing termination beneath flexible flashing at exterior face of wall at metal roof connections. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed. **No exposed drip edges or metal flashings shall extend through the face of masonry unless shown otherwise in the drawings.**
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
 2. Space vents 24 inches o.c. unless otherwise indicated.
 3. Trim vents flush with outside face of wall after mortar has set.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.15 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by flashing manufacturer.
 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 4. Lap water-resistive barrier over flashing at heads of openings.
 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.16 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches .

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Testing of masonry construction shall consist of visual inspection of rebar placement and verification of proper grouting procedures and materials. All such materials and installations shall comply with plans and specifications and shall conform to requirements of applicable codes and code requirements. Where special inspection is required, conform to NCMA approved special inspection requirements.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.18 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Repair chips on smooth finished calcium silicate manufactured stone units with patch kits furnished by manufacturer.
- C. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels without damaging surface.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces (saturate) with water and flush off loose mortar and dirt before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean calcium silicate manufactured stone masonry as follows:
 - a. Dilute proprietary cleaner with clean water in controlled proportions applied according to manufacturer's written instructions.
 - b. Apply solution to pre-soaked wall surface using soft bristled brush or low pressure acid-resistant sprayer.
 - c. Thoroughly rinse cleaning solution and residue from wall surface.
 - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 - 8. Clean stone trim to comply with stone supplier's written instructions.
 - 9. Clean limestone units and calcium silicate manufactured stone to comply with recommendations in ILI's "Indiana Limestone Handbook."
 - 10. Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

3.19 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-stone trim.
2. Coping
3. Wall Caps

B. Related Sections:

1. Section 042000 "Unit Masonry" for installing cast-stone units in unit masonry.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast-stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples:

1. For each color and texture of cast stone required.
2. For colored mortar.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:** A qualified manufacturer of cast-stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the work and to minimize the need for on-site storage.**

- B. Pack, handle, and ship cast-stone units in suitable packs or pallets.**

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast-stone units if required, using dollies with wood supports.
2. Store cast-stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements:
 1. Comply with hot-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 CAST-STONE UNITS

- A. Manufacturers
 1. Joplin Building Material, Co. or equal.
 2. Arriscraft International or equal.
- B. Cast-Stone Units: Comply with ASTM C 1364.
 1. Units shall be manufactured using the **vibrant dry tamp** method.
 2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 3. Provide drips on projecting elements unless otherwise indicated.
- D. Fabrication Tolerances:
 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- E. Cure Units as Follows:
 1. Cure units in enclosed, moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F or above.

- c. No fewer than seven days at mean daily temperature of 50 deg F or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F or above.
- F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- G. Colors and Textures: **As selected by Architect from manufacturer's full range.**
 - 1. Cast stone coping, wall caps and trim to match finish and color of adjacent Calcium Silicate Manufactured Stone Masonry finish (color varies by location).

2.2 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."

2.3 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.
 - 1. Provide Dovetail Type Pin Anchor at top of wall coping conditions.
- B. Dowels: 1/2-inch diameter round bars, fabricated from steel complying with ASTM A 36/A 36M and hot-dip galvanized to comply with ASTM A 123/A 123M.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
 - 1. Refer to 042000 UNIT MASONRY ASSEMBLIES.

2.4 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
 - 1. For setting mortar, use **Type S**.
 - 2. For pointing mortar, use **Type N**.
- B. Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
- C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

2.5 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C 1364.
 - 1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Locations: Fireplace mantle and hearth assembly.
- B. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."
- C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- E. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints **1/4 to 3/8 inch** wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
 - 7. Keep joints at shelf angles open to receive sealant.
- F. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- G. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- H. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- I. Rake out joints for pointing with sealant to depths of not less than 3/4 inch. Scrub faces of units to remove excess mortar as joints are raked.
- J. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."
 - 1. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- K. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than **3/8 inch**.
 - 4. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Locations: Sill and Top of wall coping/cap conditions.
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- C. Keep cavities open where unfilled space is indicated between back of cast-stone units and backup wall; do not fill cavities with mortar or grout.
- D. Fill anchor holes with sealant.
 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- E. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- F. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast-stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 1. Form open joint of width indicated, but not less than 3/8 inch.
- G. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- H. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/4 inch in 20 feet maximum.
- B. Variation from Level: Do not exceed 1/4 inch in 20 feet maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

- C. In-Progress Cleaning: Clean cast stone as work progresses.
1. Remove mortar fins and smears before tooling joints.
 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION - 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections:
 - 1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
 - 2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches .
 - 2. Welded built-up members with plates thicker than 2 inches .
 - 3. Column base plates thicker than 2 inches .
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.
- F. AEES: Structural steel designated as "architecturally exposed structural steel" or "AEES" in the Contract Documents.
- G. Category 2 AEES: AEES that is within 20 feet (6 m) vertically and horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AEES-2" in the Contract Documents.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand critical welds.
 - 8. For structural-steel connections indicated to comply with design loads, include structural design data
- C. Shop Drawings: Show fabrication of AESS components.[Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.]
 - 1. Locations: First floor steel exposed to view.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment Drawings.
 - 4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. **Indicate grinding, finish, and profile of welds.**
 - 5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. **Indicate orientation of bolt heads.**
 - 6. Indicate exposed surfaces and edges and surface preparation being used.
 - 7. Indicate special tolerances and erection requirements.
- D. Welding Procedure Specifications [WPSs] and Procedure Qualification Records [PQRs]: Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- B. Welding certificates.
 - 1. Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- F. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
1. AISC 3D3.
 2. AISC 360.
 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and bridges."
- G. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 FIELD CONDITIONS

- A. Field Measurements: Where AECS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, M-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A B47/A B47M, structural tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: Standard.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- D. Shear Connectors: ASTM A 10B, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- F. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 3. Finish: Plain.

- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.
 - d. Seismic Energy Products, L.P.
 - 2. Mating Surfaces: PTFE and PTFE.
 - 3. Coefficient of Friction: Not more than 0.05.
 - 4. Design Load: Not less than 5,000 psi.
 - 5. Total Movement Capability: 2 inches.

2.3 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- C. In addition to special care used to handle and fabricate AESS, comply with the following:

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of **Category 2** AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate **Category 2** AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate **Category 2** AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate **Category 2** AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Seal-weld open ends of hollow structural sections with 3/8-inch [9.5-mm] closure plates for **Category 2** AESS.
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for **Category 2** AESS.
- E. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- F. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- G. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where **Category 2** AESS is exposed to weather.
 4. Provide continuous welds of uniform size and profile where **Category 2** AESS is welded.
 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for **Category 2** AESS.
 6. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for **Category 2** AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.

7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth **Category 2** AESS.
8. At locations where welding on the far side of an exposed connection of **Category 2** AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
9. Make fillet welds for **Category 2** AESS oversize and grind to uniform profile with smooth face and transition.
10. Make fillet welds for **Category 2** AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
 3. Galvanize columns, beams, connections, and miscellaneous steel exposed to exterior.

2.10 SOURCE QUALITY CONTROL

- A. Testing and Inspecting: Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
 - 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect **Category 2** AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
- C. Base Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of base and bearing plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
 - F. Splice members only where indicated.
 - G. Do not use thermal cutting during erection [unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M].
 - H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
 - I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug-tightened.
 2. Orient bolt heads in **same direction for each connection and to maximum extent possible in same direction for similar connections.**
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs **where indicated**, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
- C. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for **Category 2** AECS.
 2. Remove erection bolts in **Category 2** AECS, fill holes, and grind smooth.
 3. Fill weld access holes in **Category 2** AECS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. At AESS Locations: Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-composite form deck.
 - 2. Composite form deck.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
 - 2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 4. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
 - 5. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 NONCOMPOSITE FORM DECK

- A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 G60 zinc coating.
 - 2. Profile Depth: As Indicated
 - 3. Design Uncoated-Steel Thickness: As Indicated.
 - 4. Span Condition: **Triple span or more.**
 - 5. Side Laps: **Overlapped**

2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.
 - 2. Profile Depth: As indicated.
 - 3. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).
 - 4. Span Condition: As indicated.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi of same material and finish as deck, and of thickness and profile indicated or recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: as indicated.
 - 2. Weld Spacing: Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches and as follows:
 - 1. As indicated.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **1-1/2 inches**, with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 78D and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

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SECTION - 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior non-load-bearing wall framing.
2. Interior load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Floor joist framing.
5. Ceiling joist framing.
6. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for connections.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at **Project site**.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.**

- B. Product Test Reports:** For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications:** Qualified according to ASTM E 329 for testing indicated.

- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
- D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: **As indicated.**
 - 2. Deflection Limits: Design framing systems to withstand **design loads** without deflections greater than the following:
 - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of **1/360** of the wall height.
 - b. Interior Load-Bearing Wall Framing: Horizontal deflection of **1/360** of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of **1/360** of the wall height.
 - d. Floor Joist Framing: Vertical deflection of **1/360** for live loads and 1/240 for total loads of the span.
 - e. Roof Rafter Framing: Vertical deflection of **1/240** of the horizontally projected span for live loads.
 - f. Ceiling Joist Framing: Vertical deflection of **1/360** of the span for live loads and 1/240 for total loads of the span.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of **3/4 inch**.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
 - 1. Floor and Roof Systems: AISI S210.
 - 2. Wall Studs: AISI S211.
 - 3. Headers: AISI S212.
 - 4. Lateral Design: AISI S213.

- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H.
 - 2. Coating: G60.
- B. Steel Sheet for Vertical Deflection Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33.
 - 2. Coating: G60.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 FLOOR JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, punched with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel joists.
 - 2. Flange Width: 1-1/4 inches, minimum.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: **0.0428 inch**.
 - 2. Flange Width: **1-5/8 inches**, minimum.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: **0.0428 inch**.
 - 2. Flange Width: **1-5/8 inches**, minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554 Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20
- B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.

- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 - 2. Connect drift clips to cold-formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at 96-inch centers.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: **As indicated.**
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated **on Shop Drawings.**
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated **on Shop Drawings.** Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION - 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Steel framing and supports for operable partitions.
3. Steel framing and supports for overhead doors.
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Steel pipe columns for supporting wood frame construction.
9. Miscellaneous steel trim including **loading-dock edge angles**.
10. Metal bollards.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections

C. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."
4. Section 057300 "Decorative Metal Railings."

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4:
 1. Size of Channels: **1-5/8 by 1-5/8 inches., or as required.**
 2. Material: ASTM A 653/A 653M, **Grade 33**, with standard coating.
- F. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

- G. Aluminum Extrusions: ASTM B 221 , Alloy 6063-T6.

2.3 WEATHERING STEEL, COR-TEN®

- A. **Weathering Steel Surfaces:** Provide materials with smooth, flat surfaces unless otherwise indicated. Weather steel finish shall be exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes or paint. Sand blast to remove any and all mill-scale after fabrication of pieces. Wash fabricated items with salt-water bath and store in same orientation as intended erection. Fabricated pieces shall be stored offsite in a protected location for 30 days minimum and delivered no more than 24 hours prior to erection. Protect erected items from construction activities. Wash with potable water periodically as required to remove any soil or debris that could cause staining.
- B. Plate and Sheet: ASTM A588, ASTM A709-50W, **A242**.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 , Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless-steel fasteners for fastening aluminum.
 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 ; with hex nuts, ASTM F 594 ; and, where indicated, flat washers; Alloy Group 13.
- D. Eyebolts: ASTM A 4B9.
- E. Machine Screws: ASME B18.6.3 .
- F. Lag Screws: ASME B18.2.1 .
- G. Wood Screws: Flat head, ASME B1B.6.1.
- H. Plain Washers: Round, ASME B1B.22.1 .
- I. Lock Washers: Helical, spring type, ASME B18.21.1 .
- J. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- L. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- M. Post-Installed Anchors: Torque-controlled expansion anchors.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 , Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593 , and nuts, ASTM F 594 .

- N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime [exterior] miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Cap bollards with 1/4-inch-thick steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- C. Prime bollards with zinc-rich primer.

2.10 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: Horizontal, to discharge into pipe.
- B. Prime cast iron downspout boots with zinc-rich primer.

2.11 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.12 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.16 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 [Mechanical Finish: as fabricated, unspecified].

2.17 METAL BAR GRATING

- A. Welded Steel Grating:
 - 1. Bearing Bar Spacing: As indicated on drawings.
 - 2. Bearing Bar Depth: As indicated on drawings.
 - 3. Bearing Bar Thickness: As indicated on drawings.
 - 4. Crossbar Spacing: As indicated on drawings.
- B. Delegated Design: Engage a qualified professional engineer to design gratings if not indicated on drawings.
- C. Shop Assembly: Fabricate grating section in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Weld adjoining members together to form a single unit where indicated.
- D. Cut, drill, and punch materials cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- E. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- F. Fit exposed connects accurately together to form hairline joints.
- G. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.
- H. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work. Provide steel tube frame as indicated on drawings.
- I. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base materials.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- J. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate connections to fit grating units and weld to units in shop unless otherwise indicated.
 - 2. Fabricate grating for attaching in the field.
- K. Fabricate cutouts in grating section for penetration indicated. Arrange cutouts to permit grating removal without disturbing items penetrating grating.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- L. Fabricate grating section as indicated in longest lengths possible. End to end connections shall be centered over supporting members below. Fabricated end-to-end joints at sunshade to eliminate double crossbars. Provide typical spacing between crossbars at end-to-end connections.
 - 1. Edge-band exposed ends of grating with bars of same size and material as bearing bars.
- M. Do not notch bearing bars at supports to maintain elevation.

N. Grating Frames and Supports: As indicated on drawings.

1. Fabricate from metal shapes, plates, and bars of welded construction to size, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections. Cut, drill, and tap units to receive hardware and similar items.
2. Unless otherwise indicated, fabricate from same basic metal as grating.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 1. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.

- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.4 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

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SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel and iron decorative railings.

1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.3 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

- C. Preconstruction test reports.
- D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel and Iron Decorative Railings: **As indicated on drawings.**
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
 - 3. Railing shall comply with all requirements of ADA and OSHA regulations.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Handrails shall be designed, fabricated, and installed to comply with applicable codes and regulations
 - 1. Handrail: 2 inches x 5/8 inch steel plate or as indicated in drawings.
 - 2. Handrail clearance from wall: As indicated on drawings or 1 1/2 inches [38 mm] minimum.
- F. Exposed fasteners shall be of same materials, color and finish as material to which applied. Exposed surfaces throughout project shall have same inherent texture and color for similar locations.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
 - 1. Provide formed-steel brackets with predrilled hole for bolted anchorage.

2.4 STEEL AND IRON

- A. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Pipe: ASTM A 53/M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
 - 1. Style Designation: Match existing or as indicated by drawings.

2.5 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; **Type 304** stainless-steel fasteners where exposed.
 - 2. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 3. Dissimilar Metals: **Type 304** stainless-steel fasteners.
- A. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

2.6 MISCELLANEOUS MATERIALS

- A. Electrical Components: Provide internal, fluorescent light fixtures and electrical components, required as part of illuminated railings, that comply with NFPA 70, are listed and labeled by a qualified testing

agency as defined in NFPA 70, and are marked for intended location and application.

- B. Low-Emitting Paints and Coatings:
 - 1. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed VOC content limit of 250 g/L.
 - 2. Paints and coatings applied to interior decorative metals shall not exceed 150 g/L
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" & Section 099123 "Interior Painting."
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: Water-based galvanized metal primer complying with MPI#134.
- I. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- J. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion

- resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- J. Form changes in direction as detailed. Miter corners.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, core drill not less than 5 inches with inside dimensions not less than 1/2 inch greater than outside dimensions of post.
- Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 ILLUMINATED RAILINGS

- A. General: Comply with requirements in this Section for aluminum railings with welded connections.
- B. Illuminated Units: Provide internal illumination using concealed, internally wired LED-strip fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with those of the power supply provided.
 - 1. LED Tubes: Provide number of tubes indicated in drawings or required by railing length.
 - 2. Diffusers: UV-stabilized acrylic diffusers matching profile of railings.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of

approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.10 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- E. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Do not apply primer to galvanized surfaces.

- F. Paint: Color: As indicated by drawings, match Architect's sample.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum and copper alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **nonshrink, nonmetallic grout**, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.3 ATTACHING RAILINGS

- A. Attach railings to wall or guard with wall brackets as indicated on drawings. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Anchor railing ends to concrete and masonry with railing ends and anchored to wall construction with anchors and bolts.
- C. Attach handrails to walls with wall brackets (except where extended to ground). Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 ADJUSTING AND CLEANING

- A. Protect installed products and finished surfaces from damage during construction.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 057300

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SECTION - 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimensional lumber.
2. Framing with engineered wood products.
3. Rooftop equipment bases and support curbs.
4. Wood blocking, and nailers.
5. Wood furring.
6. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing."
2. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

1.2 DEFINITIONS

- A. Dimension Lumber:** Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. OSB:** Oriented strand board.
- C. Timber:** Lumber of 5 inches nominal size or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:**
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Power-driven fasteners.
 - 5. Powder-actuated fasteners.
 - 6. Expansion anchors.
 - 7. Post-installed anchors.
 - 8. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: The following wood products shall be certified as "FSC Pure" according to FSC STD-D1-00 and FSC STD-40-004.
 - 1. Dimension lumber.
 - 2. Laminated-veneer lumber.
 - 3. Parallel-strand lumber.
 - 4. Prefabricated wood joists.
 - 5. Rim boards.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
- D. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 289B. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
1. Framing for raised platforms.
 2. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Ceiling Joists: Construction or No. 2 grade.
1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Douglas fir-larch; WCLIB or WWPA.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB or WWPA.
 - e. Douglas fir-south; WWPA.
 - f. Spruce-pine-fir (south); NLMA, WCLIB, or WWPA.
- B. Joists, Rafters, and Other Framing Not Listed Above: No. 2 grade.
1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Douglas fir-south; WWPA.
 - c. Douglas fir-larch (north); NLGA.
- C. Joists, Rafters, and Other Framing Not Listed Above: Any species of machine stress-rated dimension lumber with a grade of not less than **1650f-1.6E**.
- D. Joists, Rafters, and Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least **1,600,000 psi** and an extreme fiber stress in bending of at least **900 psi** for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

2.5 ENGINEERED WOOD PRODUCTS

- A. Composite Wood Products: Products shall be made without urea formaldehyde.
- B. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal (286-mm actual) depth members.
 2. Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa).

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
 2. Nailers.
 3. Furring.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
1. Mixed southern pine; SPIB.
 2. Hem-fir; WCLIB or WWPA.
 3. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 4. Western woods; WCLIB or WWPA.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine; No. 2 grade; SPIB.
 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 2 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Bolts: Steel bolts complying with ASTM A 307, Grade A ; with ASTM A 563 hex nuts and, where indicated, flat washers.
- E. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

2.9 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following (or approved equal):
1. Cleveland Steel Specialty Co.
 2. KC Metals Products, Inc.
 3. Phoenix Metal Products, Inc.
 4. Simpson Strong-Tie Co., Inc.
 5. USP Structural Connectors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
1. Use for wood-preserved-treated lumber and where indicated.
- E. Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges at least 85 percent of joist depth.
1. Thickness: **0.050 inch.**
- F. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.
- G. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
- H. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
1. Width: **3/4 inch.**
 2. Thickness: **0.050 inch**
 3. Length: **As indicated.**
- I. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. **Tie fastens to side of rafter or truss, face of top plates, and side of stud below.**
- J. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
- K. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.
- L. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
1. Bolt Diameter: as indicated.
 2. Width: as indicated.
 3. Body Thickness: as indicated.
 4. Base Reinforcement Thickness: as indicated.

2.10 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, **butyl rubber or rubberized-asphalt** compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing **Furring and Sleepers** to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Adhesives shall have a VOC content of **70 g/L** or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- D. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- E. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

- K. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 2-by-2-inch nominal- size furring **vertically** at **16 inches o.c.**
- C. Furring to Receive Gypsum Board: Install 2-by-2-inch nominal- size furring vertically at **16 inches o.c.**

3.4 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs. Fasten plates to supporting construction unless otherwise indicated.
 - 1. For exterior walls, provide **2-by-6-inch nominal-size** wood studs spaced **16 inches o.c.** unless otherwise indicated.
 - 2. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.

2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.
- D. Provide diagonal bracing in walls, at locations indicated, at 45-degree angle, full-story height unless otherwise indicated. Use **1-by-4-inch nominal**-size boards, let-in flush with faces of studs.

3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and **toe nail** or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal-size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.6 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061200 - STRUCTURALLY INSULATED PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Structural Insulated Panels (SIPs).
- B. Related Sections: Section(s) related to this section include:
 - 1. Section 061000 Rough Carpentry

1.2 SYSTEM DESCRIPTION

Structural Insulated Panels (SIPs) framing system consist of oriented strand board (OSB), structural lumber and polyurethane foam, connectors and fasteners supplied by manufacturer, all as shown on drawings, specified herein, and or described in manufacturers architectural detail binder.

1.3 REFERENCES

- A. ICC ES ACO4 - Acceptance Criteria for Sandwich Panels.
- B. ICC ES ACO5 - Acceptance Criteria for Sandwich Panel Adhesives.
- C. EPA - Registered products listing.

1.4 SUBMITTALS

- A. Product Data: Submit product data for specified products.
 - 1. Manufacturers' product sheet, evidence of code compliance, including current test data and listing report, calculations by an architect or professional engineer.
 - 2. Manufacture to provide complete panel shop drawings, showing all panel sizes, electrical layout, door and window openings and any other structural elements.
 - 3. Manufacturer's Instructions: SIP Manufacturer's construction detail book and load design charts.
- B. Calculations: Provide structural calculations by a registered architect or professional engineer qualified to perform such work.
- C. Quality Assurance Submittals: Submit the following:
 - 1. Certificate: Product certificate showing compliance to Third Party Quality Control program.
- D. Warranty: Warranty documents specified herein.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
- B. Source Limitations: Obtain all SIPs through one source. All accessories to be as furnished or recommended by the SIP manufacturer.

1.6 REGULATORY REQUIREMENTS:

- A. SIPs shall be recognized for compliance with International Building Code in a current third party listing report.
- B. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, SIP manufacturer's installation instructions and SIP manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination Section.

1.7 DELIVERY, STORAGE & HANDLING

- A. Ordering: Comply with SIP manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials from SIP manufacturer with identification labels or markings intact.
- C. Off-load SIPs from truck and handle using forklift or other means to prevent damage to SIPs.
- D. SIPs shall be fully supported in storage and prevented from contact with the ground.
- E. SIPs shall be fully protected from weather. Protect against exposure to rain, water, dirt, mud, and other residue that may affect SIP performance. Cover stored SIPs with breathable protective wraps. SIPs shall be stored in a protected area.

1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit SIP manufacturer's standard warranty document. SIP Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: [20] years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 Manufacturers:

- A. Thermocore Panel System, 1801 Hancel Parkway, Mooresville, IN 46158 or equal.

2.2 Materials

- A. SIPs consisting of the following:
 - 1. 6-1/2" foam core panels with 7/16" OSB/OSB (interior/exterior) skins. Each panel has a foam core of class 1/A polyurethane foam at a minimum density of 2.2 lbs.
 - 2. OSB identified with APA or PFS performance mark with Exposure 1 durability rating and performance in accordance with DOC PS-2 span rating 24/16 or greater.
 - 3. Core is a Class 1/A fire rated polyurethane foam with a minimum density of 2.2 lbs.
 - 4. All panels are manufactured to a thickness tolerance of +/- 3/32"
 - 5. All lumber used in panel manufacturing shall be #2 or better SPF.

2.3 Accessories

- A. Fasteners: corrosion resistant SIP screws compatible with SIP system shall be provided by the SIPs manufacturer.

1. Wood Screws for attachment to wood members
 2. Heavy Duty Metal Screws for attachment to metal members (18 gauge to 3/16")
 3. Light Duty Metal Screws for attachment to metal decks (18 gauge or thinner)
- B. SIP Gasket. Foam Gasket shall be provided by the SIP manufacturer.
- C. Dimensional Lumber: SPF, #2 or better.

2.4 Fabrication

- A. Sizes: SIPs shall be fabricated in accordance with approved Shop Drawings
- B. Thermal Resistance, R-value
1. Walls: 6 1/2" thick SIP with R-value of 40
 2. Roof: 6 1/2" thick SIP with R-value of 40

2.5 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions for equal products will be reviewed at time of bidding.

2.6 RELATED MATERIALS

- A. Related Materials: Refer to other sections for related materials as follows:
1. Dimensional Lumber: SPF #2 or better. Refer to Division 6 Carpentry Sections.

2.7 SOURCE QUALITY

- A. Source Quality Assurance: Each SIP component required shall be supplied by SIP manufacturer and shall be obtained from selected SIP manufacturer or its approved supplier.
1. Each SIP shall be labeled indicating Third Party certification.
 2. Provide evidence of Third Party inspection and labeling of all insulation used in manufacture of SIPs.
 3. Dimensional Tolerance - shall comply with values listed in the manufacturer's Quality Control Manual.
- B. Source Quality: Obtain SIPs from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's listing report, Load Design Charts, Detail Book, Shop Drawings, and product data for installation.
- B. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail and load design values shall be calculated and signed and/or sealed by a qualified architect/engineer.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

1. Verify conditions of foundation/structural system/substrate and other conditions that affect installation of SIPs. Any adverse conditions shall be reported in writing. Do not proceed with installation until adverse conditions are corrected.

3.3 INSTALLATION

- A. SIP Installation: Complete installation recommendations are available from the manufacturer. SIP weight and contractor preference will dictate the erection method used. The use of a crane or lift truck may be required for SIP placement. Consult with SIP manufacturer for recommended handling methods. Supplementary lifting clamps and attachments to be provided by the contractor.

1. SIP Supports: Provide level and square foundation/structural system/substrate that support wall and/or roof SIPs. For wall SIPs, hold sill plate back from edge of rim board 7/16" to allow full bearing of OSB skins. Provide 1 1/2" diameter access holes in plating to align with electrical conduit SIPs. Provide adequate bracing of SIPs during erection. Remove debris from plate area prior to SIP placement.
2. SIP Fastening: Connect SIPs by nails or staples as shown on drawings. Screws of equal strength may be substituted for nails and staples as specified by engineer. SIP sealant gasket must be used together with each fastening techniques. Where SIP Screw Fasteners are used, provide a minimum of 1" penetration into support. Join SIPs using tongue and groove. Secure attachment with nails, staples, or screws. Apply foam sealant gasket as per SIP manufacturer recommendations.
3. Thermal Barriers: Interior surfaces of SIPs shall be finished with a minimum 15-minute thermal barrier, such as 1/4" gypsum wallboard, nominal 1" wood paneling, or other approved materials. Apply code approved thermal barriers according to SIP manufacturer's recommendations.
4. Restrictions: Do not install SIPs directly on concrete. Do not cut or alter SIPs without consulting SIP manufacturer. SIPs shall be protected from exposure UV light and moisture.
5. Remove and replace insulated wall or roof SIPs that have become excessively wet or damaged before proceeding with installation of additional SIPs or other work.

3.4 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction.
 - 1. Roof SIPs: Protect roof SIPs from weather at all times. Provide temporary protection at the end of the day or when rain or snow is imminent.
 - 2. After installation, cover SIPs to prevent contact with water on each exposed SIP edges and faces. Failure to do so can result in edge swelling.

END OF SECTION 061200

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SECTION - 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Roof sheathing.
 - 3. Subflooring.
 - 4. Sheathing joint and penetration treatment.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for plywood backing panels.
 - 2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Product Data for composite wood products, documentation indicating that product contains no urea formaldehyde.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- C. Oriented Strand Board: DOC PS 2.
- D. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- E. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305.

Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings, and the following:
 - 1. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/O.
 - 2. Nominal Thickness: Not less than 1/2 inch .
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 16/O.
 - 2. Nominal Thickness: Not less than 1/2 inch .
- C. Cementitious Backer Units: ASTM C 1325, Type A.
 - 1. Thickness: 5/8 inch.

2.6 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/O.
 - 2. Nominal Thickness: Not less than 1/2 inch .
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 16/O.
 - 2. Nominal Thickness: Not less than 1/2 inch .

2.7 SUBFLOORING

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, single-floor panels.
 - 1. Span Rating: Not less than 16.
 - 2. Nominal Thickness: Not less than 23/32 inch.
 - 3. Edge Detail: Tongue and groove.
 - 4. Surface Finish: Fully sanded face.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D [EPA Method 24].

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Subflooring:
 - a. Glue and nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.
 - 2. Wall and Roof Sheathing:
 - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with **screws**.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 061600

SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes framing using structural glued-laminated timber.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.2 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 3. For connectors. Include installation instructions.
- B. Shop Drawings:
 - 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
 - 2. Indicate species and laminating combination.
 - 3. Include large-scale details of connections.
- C. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber[including variations due to specified treatment].
 - 1. Apply specified factory finish to three sides of half length of each Sample.
- D. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A19D.1.
- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. **Vendor Qualifications:** A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. **General:** Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. **Delegated Design:** Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.
- B. **Structural Performance:** Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.
- C. **Seismic Performance:** Structural glued-laminated timber and connectors shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. **General:** Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 - 2. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
 - 3. Provide structural glued-laminated timber made from single species.
 - 4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
 - 5. **Adhesives:** Do not use adhesives that contain urea formaldehyde.
- B. **Certified Wood:** Wood products shall be certified as "FSC Pure" or "FSC Mixed" according to FSC STD-D1-00 and FSC STD-40-004.
- C. **Species and Grades for Structural Glued-Laminated Timber:** **Douglas fir-larch, Southern pine or a preapproved species** that complies with structural properties indicated.
- D. **Species and Grades for Beams:**
 - 1. **Species and Beam Stress Classification:** Douglas fir-larch, 24F-1.BE

2. Lay-up: Balanced.
- E. Appearance Grade: Premium, complying with AITC 110.
1. For Premium and Architectural appearance grades, fill voids as required by AITC 110.[For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.]

2.3 PRESERVATIVE TREATMENT

- A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWP A U1, Use **Category 1**.
1. Use preservative solution without **water repellents** or substances that might interfere with application of indicated finishes.
 2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.
- B. Preservative:[One of the following:]
1. Oxine copper [copper-8-quinolinolate] in a light petroleum solvent.
 2. Pentachlorophenol in light petroleum solvent.
 3. Copper naphthenate in a light petroleum solvent.
 4. Ammoniacal zinc copper arsenate [ACZA] in a water solution.
 5. Chromated copper arsenate [CCA] in a water solution.
 6. Ammoniacal copper quat Type A [ACQ-C] in a water solution.
 7. Propiconazole tebuconazole imidacloprid [PTI] in a water emulsion.
- C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWP A M4 to surfaces cut to a depth of more than 1/16 inch [1.5 mm].

2.4 TIMBER CONNECTORS

- A. Fabricate beam seats from **steel** as indicated.
- B. Fabricate beam hangers from **steel** as indicated.
- C. Fabricate hinge connectors from **steel** as indicated.
- D. Fabricate strap ties from steel as indicated.
- E. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.
- F. Provide bolts, 3/4 inch [19 mm] unless otherwise indicated, complying with ASTM A 307, Grade A [ASTM F 568M, Property Class 4.6]; nuts complying with ASTM A 563 [ASTM A 563M]; and, where indicated, flat washers.
- G. Provide shear plates, [2-5/8 inches [66.7 mm]] in diameter, complying with ASTM D 5933.

- H. Materials: Unless otherwise indicated, fabricate from the following materials:
1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- I. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.
- J. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWP A M4.
1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. End-Cut Sealing: Immediately after end cutting each member to final length (and after preservative treatment), apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit (except for preservative-treated wood where treatment included a water repellent).

2.7 FACTORY FINISHING

- A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
1. Color: As selected by Architect from manufacturer's full range.

- B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing [and finishing].
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 3. Coat cross cuts with end sealer.
 - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWWPA M4.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. Install timber connectors as indicated.
 - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

- A. Repair damaged surfaces[and finishes] after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
 - 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior wood trim.
2. Lumber soffits.
3. Exterior ornamental wood column wraps.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

1.3 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.
3. For fire-retardant-treated wood that is not marked with classification marking of testing and inspecting agency.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Cellular PVC trim.
4. Foam plastic moldings.

C. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
 - 1. For exterior ornamental wood columns, comply with manufacturer's written instructions and warranty requirements.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Certified Wood: The following wood products shall be certified as "FSC Pure" or "FSC Mixed" according to FSC STD-01-00 and FSC STD-40-004.
 - 1. Exterior trim.
 - 2. Exterior lumber soffits.
- B. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 3. RIS: Redwood Inspection Service, "Standard Specifications for Grades of California Redwood Lumber."
 - 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."

6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
- C. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 1. For exposed lumber, omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Water-Repellent Preservative Treatment by Nonpressure Process: AWPA N1; dip, spray, flood, or vacuum-pressure treatment.
 1. Preservative Chemicals: 3-iodo-2-propenyl butyl carbamate (IPBC), combined with an insecticide containing chlorpyrifos (CPF).
 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
 3. Application: Wood soffits, column wraps and exterior trim.

2.3 EXTERIOR TRIM

- A. Lumber Trim for Semitransparent-Stained Finish:
 1. Species and Grade: Douglas Fir, Clear Vertical Grain, CVG; WWPA.
 2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
 3. Finger Jointing: **Not allowed.**
 4. Face Surface: **smooth.**

2.4 LUMBER SIDING / SOFFIT

- A. Provide kiln-dried lumber siding complying with DOC PS 20.
- B. Species and Grade: Douglas Fir, Clear Vertical Grain, CVG; WWPA.
- C. Pattern: V-edge, smooth-faced tongue-and-groove pattern with eased edges, actual face width (coverage) and thickness of 5-1/8 by 23/32 inch, measured at 19 percent moisture content.

2.5 EXTERIOR ORNAMENTAL WOOD COLUMN WRAPS

- A. Fabricate column wraps from clear stock with a moisture content of not more than 15 percent.
 1. Wood Species: **Douglas Fir**
- B. Treatment and Finishing:
 1. Treat wood column wraps with water-repellant preservative by nonpressure process.

2.6 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. For face-fastening column wraps, provide **hot-dip galvanized or stainless-steel fasteners**.
 2. For pressure-preservative-treated wood, provide **hot-dip galvanized or stainless-steel fasteners**.
 3. For applications not otherwise indicated, provide **hot-dip galvanized-steel fasteners**.
- B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.
- C. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.
1. Horizontal Joint Flashing for Panel Siding: Preformed, **prefinished-aluminum**, Z-shaped flashing.
- D. Sealants: Latex, complying with ASTM C 834 **Type OP, Grade NF** and with applicable requirements in Section 079200 "Joint Sealants," recommended by sealant manufacturer and manufacturer of substrates for intended application.

2.7 FABRICATION

- A. Back out or kerf backs of standing and running trim wider than 5 inches (125 mm), except members with ends exposed in finished work. Revise paragraph below to describe conditions where eased edges are required. Delete if eased edges are not required.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
 1. Use scarf joints for end-to-end joints.
 2. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
- D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 SIDING INSTALLATION

- A. Install siding to comply with manufacturer's written instructions **and warranty requirements**.
- B. Horizontal Lumber Siding: Apply starter strip along bottom edge of sheathing or sill. Install first course of siding with lower edge at least 1/8 inch below starter strip and subsequent courses lapped 1 inch over course below. Nail at each stud. Do not allow nails to penetrate more than one thickness of siding.
 1. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
 2. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
 3. Install prefabricated outside corners as recommended by manufacturer of siding materials.
- C. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.
- D. Finish: Apply finish within two weeks of installation.

3.6 ORNAMENTAL COLUMN WRAP INSTALLATION

- A. Install column wraps located and detailed as indicated on drawings.
- B. Install column wraps plumb.
- C. Set shim as required to temporarily level, and scribe and trim as required so that top of wraps will sit level without use of shims. Fasten wraps in place to support using fasteners as indicated on drawings.
- D. Scribe and trim column wraps to fit to columns.
- E. Seal ends of column wraps with two coats of wood sealer.
- F. Secure column wraps in place at top, bottom, and intermediately with fasteners and fastening pattern as indicated on drawings.

3.7 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.8 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.9 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Interior board paneling.
3. Shelving.
4. Interior stairwork.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 099123 "Interior Painting" for interior finish carpentry.
3. Section 099300 "Staining and Transparent Finishing" for sealing of exterior wood siding soffits.

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

B. Samples: For each type of product involving selection of colors, profiles, or textures.

1. For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.
3. Lumber, panel and veneer products for transparent finish, for each species and cut, finished on one side and one edge.
4. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
- B. Sample Warranty: For manufacturer's warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Certified Wood: The following wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-D1-00 and FSC STD-40-004.
 - 1. Interior trim.
 - 2. Interior board paneling.
- A. Wood for Transparent Finish:
 - 1. Douglas Fir, Clear Vertical Grain, CVG; WWPA.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood, including eastern white pine, sugar pine, or western white pine.

- C. Composite Wood Products: Products shall be made without urea formaldehyde.
- D. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
 - 3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 - 6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."
- E. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece **or omit grade stamp and provide certificates of grade compliance issued by inspection agency.**
- F. Softwood Plywood: DOC PS 1.
- G. Hardboard: AHA A135.4.
- H. MDF: ANSI A208.2, **Grade 130.**
- I. Particleboard: ANSI A208.1, **Grade M-2.**
- J. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - 1. Color: **White.**

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish [Stain or Clear Finish]:
 - 1. Species and Grade: Douglas Fir, Clear Vertical Grain, CVG; WWPA.
 - 2. Maximum Moisture Content: **10** percent.
 - 3. Finger Jointing: Not allowed.
 - 4. Gluing for Width: **Allowed.**
 - 5. Veneered Material: **Not allowed**
 - 6. Face Surface: **Surfaced smooth.**
 - 7. Matching: Selected for compatible grain and color.
- B. Lumber Trim for Opaque Finish [Painted Finish]:
 - 1. Species and Grade: Any closed-grain hardwood, including eastern white pine, sugar pine, or western white pine.
 - 2. Maximum Moisture Content: **15** percent with **at least 85 percent of shipment at 12 percent or less.**
 - 3. Finger Jointing: **Not allowed.**
 - 4. Face Surface: **Surfaced (smooth).**

2.3 PANELING

- A. Board Paneling:

1. Species and Grade: Douglas Fir, Clear Vertical Grain, CVG; WWPA.
2. Maximum Moisture Content: **15 percent with at least 85 percent of shipment at 12 percent or less.**
3. Pattern: V-joint, tongue and groove, **WWPA WP 4.**
4. Net Coverage Width: **4 inches.**

2.4 SHELVING

- A. Closet: Made from the following material, 3/4 inch thick.
 1. Melamine-faced particleboard with **applied-PVC** front edge.
- B. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.
- C. Standards for Adjustable Shelf Supports: BHMA A156.9, B04071; **powder-coat-finished steel.**
- D. Adjustable Shelf Supports: BHMA A156.9, B040B1 or B04091; **powder-coat-finished steel.**

2.5 STAIRS AND RAILINGS

- A. Risers: **3/4-inch** finish boards as specified above for interior lumber trim for transparent finish.
- B. Treads: **3/4-inch** finish boards as specified above for interior lumber trim for transparent finish.

2.6 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
 1. Adhesives shall have a VOC content of **30 g/L or less.**
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
 1. Adhesives shall have a VOC content of **50 g/L or less.**
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
 1. Adhesives shall have a VOC content of **70 g/L or less.**
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.7 FABRICATION

- A. Back out or kerf backs of the following members except those with ends exposed in finished work:
 - 1. Interior standing and running trim except shoe and crown molds.
 - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

2.8 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
- C. Transparent Finish:
 - 1. Grade: **Custom**.
 - 2. AWI Finish System: **Water-based Polyurethane**.
 - 3. Staining: **None required**.
 - 4. Sheen: **Semigloss, 46-60** units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours (unless longer conditioning is recommended by manufacturer).

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. **[Cope]** **[Miter]** at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 2. Install trim after gypsum-board joint finishing operations are completed.
 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 PANELING INSTALLATION

- A. Board Paneling: Install according to manufacturer's written instructions. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
 1. Install in full lengths without end joints.
 2. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards. Install with uniform tight joints between boards.
 3. Fasten paneling by blind nailing through tongues.
- B. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- C. Paneling: Anchor paneling to supporting substrate with **concealed panel-hanger clips**. Do not use face fastening, unless **otherwise indicated**.

3.6 SHELVING AND CLOTHES ROD INSTALLATION

- A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.
- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches o.c.
 1. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing. Remove adhesive that is squeezed out after fastening shelf cleats in place.
- C. Install shelf brackets according to manufacturer's written instructions, spaced not more than **36 inches o.c.** Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.

- E. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of end of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- F. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
 - 1. Fasten shelves to cleats with finish nails or trim screws, set flush.
 - 2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

3.7 STAIR AND RAILING INSTALLATION

- A. Treads and Risers at Interior Stairs: Secure treads and risers by gluing and nailing to supporting substrates and framing.
 - 1. Extend tread finish material over riser finish material at corners at set nosing flush with riser face.
 - 2. Install stairs with treads and risers no more than 1/8" from indicated position.
- B. Railings: Secure wall rails with metal brackets as indicated. Fasten freestanding railings to tread or slab as indicated. Provide countersunk-head fasteners.

3.8 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.9 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.10 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

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SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architectural wood cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
3. Shop finishing of architectural wood cabinets.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 062023 "Interior Finish Carpentry" for interior wood trim and siding.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, fire-retardant-treated materials, cabinet hardware and accessories, and finishing materials and processes.

1. For adhesives and composite wood products, documentation indicating that products contain **no urea formaldehyde**.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

C. Samples:

1. Lumber for transparent finish, for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.
3. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
4. Thermoset decorative panels, for each color, pattern, and surface finish.
5. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.3 DELIVERY, STORAGE, AND HANDLING

- A.** Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.4 FIELD CONDITIONS

- A.** Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOOD CABINETS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.

2.2 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: **Premium.**
- B. Type of Construction: **Frameless.**
- C. Cabinet and Door and Drawer Front Interface Style: **Flush overlay.**
- D. Reveal Dimension: **1/8 inch**, unless otherwise noted on drawings.
- E. Wood for Exposed Surfaces: **As indicated.**
 - 1. Species: **Douglas Fir, Sapwood Only.**
 - 2. Cut: **Quarter sawn.**
 - 3. Grain Direction: **Vertically for drawer fronts, doors, and fixed panels.**
 - 4. Matching of Veneer Leaves: **Slip match.**
 - 5. Veneer Matching within Panel Face: **Balance match.**
- F. Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: **Same species and cut indicated for exposed surfaces.**
 - 2. Drawer Subfronts, Backs, and Sides: **Thermoset decorative panels with PVC or polyester edge banding.**
 - 3. Drawer Bottoms: **Thermoset decorative panels.**

2.3 WOOD CABINETS FOR OPAQUE FINISH

- A. Grade: **Premium.**
- B. Type of Construction: **Frameless.**
- C. Cabinet and Door and Drawer Front Interface Style: **Flush overlay.**
- D. Reveal Dimension: **1/8 inch**, unless otherwise noted on drawings.
- E. Species for Exposed Lumber Surfaces: **Any closed-grain hardwood.**

- F. Panel Product for Exposed Surfaces: Medium-density overlay.
- G. Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: **Thermoset decorative panels.**
 - 2. Drawer Sides and Backs: **Thermoset decorative panels with PVC or polyester edge banding.**
 - 3. Drawer Bottoms: **Thermoset decorative panels.**

2.4 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: **5 to 10** percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard: ANSI A208.2, **Grade 130, made with binder containing no urea formaldehyde.**
 - 2. Particleboard: ANSI A208.1, **Grade M-2, made with binder containing no urea formaldehyde.**
 - 3. Softwood Plywood: DOC PS 1, **medium-density overlay.**
 - 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, **made with adhesive containing no urea formaldehyde.**
 - 5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware (Descriptive Specification)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, **100** degrees of opening.
- C. Back-Mounted Pulls: **EPCO DP41, 6"**.
- D. Drawer mounted file systems: **Hanging file bracket system equal to Hafele.**
- E. Catches: Push-in magnetic catches, BHMA A156.9, B03131.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; **partial-extension type, epoxy coated steel** with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; **full-extension** type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide **Grade 1.**
 - 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide **Grade 1HD-100.**
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide **Grade 1HD-200.**
 - 6. For computer keyboard shelves, provide **Grade 1HD-100.**
 - 7. For trash bins not more than 20 inches high and 16 inches wide, provide **Grade 1HD-200.**
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.

- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 63D.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: **Softwood or hardwood lumber**, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.7 FABRICATION

- A. Complete fabrication, including assembly, **finishing**, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- C. Install glass to comply with applicable requirements in Section 08B000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.8 SHOP FINISHING

- A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.
- C. Transparent Finish:
 - 1. Grade: **Premium**.
 - 2. Finish: System - 8, water-based cross linking acrylic.
 - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
 - 4. Staining: None required.
 - 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
 - 6. Sheen: **Semigloss, 46-60** gloss units measured on 60-degree gloss meter per ASTM D 523.
- D. Opaque Finish:
 - 1. Grade: **Premium**.

2. Finish: System - 8, water-based cross linking acrylic.
3. Color: **As indicated by drawings**, match approved sample for color.
4. Sheen: **Semigloss, 46-60** gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
- E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION D64113

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SECTION - 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS AND COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Plastic-laminate countertops.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.2 PREINSTALLATION MEETINGS

- A. Pre-installation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:** For each type of product, including, panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, fire-retardant-treated materials, and cabinet hardware and accessories.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

- B. Shop Drawings:** Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, electrical switches and outlets, and other items installed in architectural plastic-laminate cabinets and countertops.

C. Samples for Verification:

1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material.
2. Thermoset decorative panels, 12 by 12 inches, for each color, pattern, and surface finish.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:** Fabricator of products.

- B. Testing Agency Qualifications:** For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets and countertops until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets and countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Premium.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. Reveal Dimension: 1/8 inch, unless otherwise noted on drawings.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
- G. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Post-formed Surfaces: Grade HGP.

3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS, **matching laminate in color, pattern, and finish.**
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

H. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Patterns, matte finish.

2.2 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.
 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Premium.
- C. High-Pressure Decorative Laminate: NEMA LD 3, **Grade HGS.**
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. Match Architect's sample.
 2. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, **matte finish.**
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- F. Core Material: Medium-density fiberboard made with exterior glue or Exterior-grade plywood.
- G. Core Thickness: 1-1/2"

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 1. Wood Moisture Content: 8 to 13 percent.

- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
3. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.5 CABINET AND COUNTERTOP HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware (Descriptive Specification)."
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- C. Back-Mounted Pulls: EPCD DP41, 6".
- D. Drawer mounted file systems: Hanging file bracket system equal to Hafele.
- E. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; partial-extension type; epoxy-coated steel with polymer rollers.
 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
 4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
 6. For computer keyboard shelves, provide Grade 1HD-200.
- F. Door Locks: BHMA A156.11, E07121.
- G. Drawer Locks: BHMA A156.11, E07041.
- H. Door and Drawer Silencers: BHMA A156.16, L03011.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.1B for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

- K. Grommets for Cable Passage through Countertops: 2-inch OD, color to match surface laminate, molded-plastic grommets and matching plastic caps with slot for wire passage.
- L. Cable Passage Slots: As indicated on drawings.

2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.7 FABRICATION

- A. Fabricate cabinets and countertops to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets and countertops to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets and countertops, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- C. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
 - 2. Seal edges of cutouts by saturating with varnish.
- D. Field Jointing Countertops: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- E. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- F. Scribe and cut cabinets and countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- G. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 1. Use filler matching finish of items being installed.
- H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Secure backsplashes **to walls with adhesive.**
 3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets and countertops on exposed and semi-exposed surfaces.

END OF SECTION 064116

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cold-applied, emulsified asphalt dampproofing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. APOC, Inc.; a division of Gardner-Gibson.
 - 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 - 3. Brewer Company (The).
 - 4. ChemMasters, Inc.
 - 5. Euclid Chemical Company (The); an RPM company.
 - 6. Gardner-Gibson, Inc.
 - 7. Henry Company.
 - 8. Karnak Corporation.
 - 9. Koppers Inc.
 - 10. Malarkey Roofing Products.
 - 11. Meadows, W. R., Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- E. VOC Content: Zero
- F. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.

- C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
 - 1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- E. Protection Course: ASTM D 6506, 1/8-inch thick, semi-rigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
- F. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness 1/4 inch, with a compressive strength of not less than 8 psi per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for substrate preparation, dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
 - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.
- D. Where dampproofing interior face of above-grade, exterior concrete and masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft., or one trowel coat at not less than 4 gal./100 sq. ft.
- B. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft.

- C. Concrete Backup for Brick Veneer Assemblies: Apply one brush or spray coat at not less than 1 gal./100 sq. ft.
- D. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft.
- E. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than 1 gal./100 sq. ft.

3.3 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

END OF SECTION 071113

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SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes penetrating water-repellent coatings for the following vertical and horizontal surfaces:
 - 1. Concrete (unpainted).
 - 2. Brick masonry.
 - 3. Calcium Silicate Manufactured Stone.
 - 4. Cast Stone.
 - 5. CMU (Concrete masonry unit, unpainted and unglazed).

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's printed statement of VOC content.
- B. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.
- C. Qualification Data: For Installer and testing agency.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.
- E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 548 for testing indicated.
- C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.
 - 1. Coordinate each test application with Architect prior to application.
 - 2. Size: 25 sq. ft. (2.3 sq. m).
 - 3. Final approval by Architect of water-repellent application will be from test applications.

1.4 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Ambient temperature is above 40 deg F (4.4 deg C).
 - 2. Concrete surfaces and mortar have cured for more than 28 days.
 - 3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
 - 4. Rain or snow is not predicted within 24 hours.
 - 5. Application proceeds more than 24 hours after surfaces have been wet.

6. Substrate is not frozen, or surface temperature is above 40 deg F (4.4 deg C).
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.
- B. Water Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
 1. Clay Brick: ASTM C 67.
 2. Concrete Masonry Unit: ASTM C 140.
 3. Cast-in-Place Concrete: ASTM C 642.
 4. Cast Stone: ASTM C 1195
 5. Natural Stone: ASTM C 97/C 97M
- C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
- D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.
- E. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
- F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.
- G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
 1. Reduction of Water Absorption: 80 percent.
 2. Reduction in Chloride Content: 80 percent.

2.2 PENETRATING WATER REPELLENTS

- A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, water-based silane/siloxane water repellent for concrete, stucco, and most masonry surfaces.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. PROSOCO, Inc.; Weather Seal GP.
 2. Substrates: Concrete.
- B. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, water-based silane/siloxane water repellent for concrete and most masonry and stucco surfaces.

1. Products: Subject to compliance with requirements, provide the following:
 - a. PRDSOCO, Inc.; Siloxane PD.
 2. Substrates: Clay Brick.
- C. Silicone, Penetrating Water Repellent: Clear, solvent-based silicone elastomer formulated to weatherproof concrete block and other porous masonry materials.
1. Products: Subject to compliance with requirements, provide the following:
 - a. PROSOCCO, Inc.; Blok-Guard & Graffiti Control.
 2. Substrates: Smooth and split-faced CMU block.
- D. Modified Siloxane, Penetrating Water Repellent developed for limestone, marble and most other traditional masonry surfaces.
1. Products: Subject to compliance with requirements, provide the following:
 - a. PROSOCCO, Inc.; Natural Stone Treatment.
 2. Substrates: Limestone, marble and other natural stones.
- E. Silicone, Penetrating Water Repellent: Clear, solvent-based silicone elastomer formulated to weatherproof custom masonry units, cast stone, architectural concrete block, precast concrete, wood and porous masonry.
1. Products: Subject to compliance with requirements, provide the following:
 - a. PROSOCCO, Inc.; Custom Masonry Sealer.
 2. Substrates: Cast stone and other custom masonry units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

- B. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.
 - 1. Cast-in-Place Concrete, Cast Stone, and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents according to ASTM E 1857..
 - 2. Clay Brick Masonry: Clean clay brick masonry per ASTM D 5703. Division 4 Section.
 - 3. Natural Stone: Clean natural stone masonry per ASTM C 1515.
- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket insulation.
 - 3. Spray polyurethane foam insulation.
 - 4. Polyisocyanurate foam-plastic board.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for insulation installed in cavity walls.
 - 2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
 - 3. Section 092900 "Gypsum Board" for sound attenuation blanket used in acoustic insulation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: 12"x12"-size units for each type of exposed insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. At perimeter insulation locations (at slab and foundations), cast-in-place concrete walls and other areas as indicated on the drawings, provide:
 1. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. DiversiFoam Products.
 2. Dow Chemical Company (The).
 3. Owens Corning.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Where concealed in cavities at exterior stud framed walls and other areas as indicated on the drawings provide:
 1. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).
- B. Where unconcealed (exposed at one or both sides) at exterior stud framed walls and other areas as indicated on the drawings provide:
 1. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. CertainTeed Corporation.
 2. Guardian Fiberglass, Inc.
 3. Johns Manville; a Berkshire Hathaway Company.
 4. Knauf Fiber Glass.
 5. Owens Corning.
- D. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:

1. 3-5/8 inches (89 mm) thick with a thermal resistance of 11 deg F x h x sq.ft./Btu at 75 deg F (1.9 K x sq. m/W at 24 deg C).
2. 6 inches (140 mm) thick with a thermal resistance of 21 deg F x h x sq.ft./Btu at 75 deg F (3.7 K x sq. m/W at 24 deg C).
3. Or as indicated on the drawings.

2.4 SPRAY POLYURETHANE FOAM INSULATION

- A. At underside of first floor deck and as indicated on drawings:
1. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **25** or less.
 - b. Smoke-Developed Index: **450** or less.
 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 4. Provide application of **3" average final thickness.**
- B. Where located in wall and roof conditions on the interior side of wood substrate and as indicated in drawings:
1. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: **25** or less.
 - b. Smoke-Developed Index: **450** or less.
 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 4. Provide **R-20 minimum insulation value.**
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. BASF Corporation.
 2. Icynene, Inc.
 3. BaySystems NorthAmerica, LLC.
 4. Dow Chemical Company (The).
 5. ERSystems, Inc.
 6. Gaco Western Inc.
 7. Henry Company.
 8. NCFI; Division of Barnhardt Mfg. Co.
 9. SWD Urethane Company.
 10. Volatile Free, Inc.

2.5 POLYISOCYANURATE BOARD INSULATION

- A. At concealed cavities in masonry cavity-wall construction and other areas as indicated in drawings:
1. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches (101 mm).

- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Dow Chemical Company.
 - 2. Rmax, Inc.
 - 3. Atlas Roofing Corporation.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.6 VAPOR RETARDERS ON FRAMING

- A. At furred walls in basement area.
- B. Polyethylene Vapor Retarders: ASTM D 4397, 10 mils thick, with maximum permeance rating of 0.13 perm.
- C. Vapor Retarder Accessories:
 - 1. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 - 2. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
 - 3. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
 - 4. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

2.7 ACCESSORIES

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- B. Primer for spray foam insulation: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

2.8 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
 - 1. Available Products:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
 - c. Gemco; Spindle Type.
 - 2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 - 3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.
- B. Priming for spray foam insulation: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of **24 inches** below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of **48 inches** in from exterior walls.
- C. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.
- D. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

3.6 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.7 INSTALLATION, GENERAL

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated.
1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

- E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.8 INSTALLATION OF FOAMED-IN-PLACE INSULATION

- A. General for Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- B. Comply with insulation manufacturer's written instructions applicable to products and applications.
- C. Spray insulation to envelop entire area to be insulated and fill voids.
- D. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- E. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- F. Cavity Walls: Install into cavities to [thickness indicated on Drawings] (fully fill void).
- G. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.9 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
 - 7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward interior of construction.
 - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions and as indicated in Part 2.

3.10 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions.
 1. Firmly attach vapor retarders to framing or solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.11 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS (SHEET AIR BARRIERS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-adhering, vapor-permeable sheet air-barrier.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry".
 - 2. Section 061200 "Structural Insulated Panels".
 - 3. Section 061600 "Sheathing".

1.2 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 REFERENCES

- A. American Association of Textile Chemists and Colorists (AATCC): ATCC 127 - Test Method for Water Resistance: Hydrostatic Pressure Test.
- B. ASTM International (ASTM):
 - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E 96/E 96M - [Test Methods for Water Vapor Transmission of Materials] ASTM E398-03 - [Standard Test Method for Water Vapor Transmission Rate of Sheet Materials Using Dynamic Relative Humidity Measurement].
 - 3. ASTM E 217B - Standard Test Method for Air Permeance of Building Materials. Meets Air Barrier Association of America (ABAA) requirements for "Adhesive Backed Commercial Building Wraps".
 - 4. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- C. International Code Council Evaluation Service, Inc. (ICC-ES): ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
 - 2. Include data on air and water-vapor permeance based on testing according to referenced standards.
 - 3. Submit manufacturers' current product data sheets, details and installation instructions for the water-resistive vapor permeable air barrier membrane components and accessories.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, openings, penetrations, inside and outside corners, terminations, and ties with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- B. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

- A. Single Source: Primary fully self-adhered water-resistive vapor permeable air barrier membrane components and accessories must be obtained as a single-source membrane system to ensure total system compatibility and integrity.
- B. Manufacturer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
 - 2. Manufacturer of specified products listed in this Section to have experienced in-house technical and field observation personnel qualified to provide expert technical support.
- C. Mock-up:
 - 1. As directed by architect, construct typical exterior wall panel, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly. Detail of water-resistive vapor permeable air barrier membrane application and lap seams.
 - a. Include junction with roofing membrane, **building corner condition, and foundation wall intersection.**
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to current Product Installation Instructions by manufacturer for proper storage and handling.

- B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- C. Store roll materials on end in original packaging. Protect rolls from direct sunlight and inclement weather until ready for use.
- D. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- E. Protect stored materials from direct sunlight.

1.9 COORDINATION

- A. Ensure continuity of the fully self-adhered water-resistive vapor permeable air barrier system throughout the scope of this section.
- B. Proper installation may require more than one trade. Coordinate extent of each trade's Work and overlapping Work.

1.10 SUBSTITUTIONS

- A. Substitutions submissions to include:
 - 1. Evidence that alternate materials meet or exceed performance characteristics of specified Product requirements including documentation from an approved independent testing laboratory certifying the minimum physical dimensions, tensile strength, fire burning characteristics, vapor permeance and air leakage rates of the fully self-adhered (not-spot applied adhesive) water-resistive vapor permeable air barrier membrane without VOC's or the aid of primers or surface conditioners.
 - 2. Manufacturer's complete set of details for fully self-adhered water-resistive vapor permeable air barrier membrane system showing a continuous plane of water and air tightness throughout the building enclosure.

1.11 WARRANTY

- A. Provide manufacturer's standard material warranty in which manufacturer agrees to provide replacement material for the fully self-adhered water-resistive vapor permeable air barrier sheets installed in accordance with manufacturer's instructions that fail due to material defects within 20 years of the date of Substantial Completion.

1.12 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Provide complete fully adhered water-resistive vapor permeable air barrier membrane system.
- C. Complete Work as shown on the Drawings and specified herein to bridge gaps and seal the water-resistive vapor permeable air barrier membrane against air leakage and water intrusion.
 - 1. Connections of the walls to the roof membrane.
 - 2. Connections of the walls to the foundations.
 - 3. Seismic and expansion joints.
 - 4. Openings and penetrations of window and door frames, store front, curtain wall.
 - 5. Piping, conduit, duct and similar penetrations.
 - 6. Masonry ties, screws, bolts and similar penetrations.
 - 7. All other air leakage pathways in the building envelope.
- D. Install primary water-resistive vapor permeable air barrier, flashing, and ventilation strip accessories.

2.3 SELF-ADHERING VAPOR-PERMEABLE SHEET AIR BARRIER

- A. Self-Adhering Vapor-Permeable, Air-Barrier Sheet: Spun-bonded polypropylene.
 - 1. Primary fully self-adhered water-resistive vapor permeable air barrier membrane components and accessories must be obtained as a single-source to ensure total system compatibility and integrity.
 - a. Wrapshield SA Self-Adhered by VaproShield LLC or equal.
- B. Water-Resistive Vapor Permeable Air Barrier Materials (Basis of Design):
 - 1. Physical and Performance Properties: Fully self-adhered water-resistive vapor permeable air barrier sheet membrane consisting of multiple layers of spun-bonded polypropylene tested in accordance with ICC-ES AC 308 criteria to meet IBC and IRC requirements for weather resistive barriers having the following properties:
 - a. Allowable UV exposure for 180 days.
 - b. Adhesive: 100% coverage on back or wall side of membrane (not spot applied), vapor permeable, with Zero VOC's.
 - c. Air Leakage: <0.002 cfm/sq. ft. @ 1.57 psf [<0.01 L/s sq. m @ 75 Pa] when tested in accordance with ASTM E 2357 and <0.00002 cfm/sq. ft. @ 1.57 psf [<0.0001 L/s sq. m @ 75 Pa] when tested in accordance with ASTM E 2178. Meets Air Barrier Association of America (ABAA) requirements for "Adhesive Backed Commercial Building Wraps".
 - d. Water Vapor Permeance: When tested to ASTM E 96 Method B: average of 50 perms [350.40 g/sq. m 24h WVT]. Minimum
 - e. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage.
 - f. Breaking strength and Elongation to ASTM D 5034: 88 lbf (391 N), machine direction; 83 lbf (369 N), cross-machine direction.
 - g. Application Temperature: Ambient temperature must be above 20 degrees F (minus 6.7 degree C).
 - h. Surface Burning Characteristics tested to ASTM E 84: Class A, Flame-spread index of less than 5, Smoke-developed index of less than 15
 - i. Fire Propagation Characteristics: Passes NFPA 285 testing in approved assemblies
 - j. Physical Dimensions: 0.022 inches (0.56 mm) thick and 59 inches (1.5 m) wide and 97.06 oz/sq. ft. (257 g/sq. m).

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Water-resistive Vapor Permeable Transition and Flashing Membrane
 - 1. Self-adhered air barrier transition and flashing membrane shall be a zero VOC fully self-adhered water-resistive vapor permeable sheet membrane having the following properties:
 - a. VaproFlashing SA™ by VaproShield or equal.
 - 2. Dimension: 11-3/4 inches or 19-2/3 inches wide x 164 feet long.
 - 3. Air Leakage: <0.002 cfm/sq. ft. @ 1.57 psf [<0.01 L/s sq. m @ 75 Pa]) when tested in accordance with ASTM E 2357 and <0.00002 cfm/sq. ft. @ 1.57 psf [<0.0001 L/s sq. m. @ 75 Pa] when tested in accordance with ASTM E 217B.
 - 4. Water Vapor Permeance tested to ASTM E 96 Method B: average 50 perms (350.40 g/sq. m 24h WVT).
 - 5. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage.
- C. Vapor Permeable Water Resistive Flashing for Rough Openings
 - 1. Window and door flashing shall be a liquid-applied vapor permeable air barrier flashing material with vapor permeance and resistance to air leakage properties compatible with the primary air barrier membrane.
 - a. VaproLiqui-Flash by VaproShield or equal.
- D. Penetration Sealant
 - 1. Provide sealant for penetrations as recommended by manufacturer and as specified under Division 07 Section: Sealants.
- E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

2.5 FLEXIBLE FLASHING

- A. Comply with requirements of Section 042000, "Unit Masonry".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.

3.2 SURFACE PREPARATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify architect in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates.
- B. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. All surfaces must be dry, sound, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the water resistive air barrier membrane and flashings. Fill voids and gaps in substrate greater than 7/8 inch in width to provide an even surface. Strike masonry joints full-flush.
- D. Minimum application temperature of fully self-adhered membrane and flashings to be above 20 degrees F (minus 6.0 degrees C).
- E. Ensure all preparatory Work is complete prior to applying primary fully self-adhered vapor permeable air barrier sheet membrane.
- F. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.
- G. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- H. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- I. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- J. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- K. Bridge and cover **expansion joints and** discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints.
- L. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION, GENERAL

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.4 SELF-ADHERED VAPOR PERMEABLE AIR BARRIER MEMBRANE INSTALLATION

- A. General: Install air barrier sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations.
- B. Self-adhered vapor permeable air barrier sheets may be installed vertically or horizontally over the outside face of exterior sheathing board or substrate.
- C. Complete detail Work around corners, wall openings, building transitions and penetrations prior to field applications.
- D. Install fully self-adhered vapor permeable air barrier sheet over the outside face of exterior sheathing board or substrate, measure and pre-cut into manageable sized sheets to suit the application conditions.
- E. Install fully self-adhered vapor permeable air barrier sheet complete and continuous to substrate in a sequential minimal 3 inch (76.2 mm) overlapping weatherboard method (shingled) starting at bottom or base of wall and working up.
- F. Apply and firmly adhere sheets. Accurately align sheets and maintain uniform minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
- G. Roll installed membrane with roller to ensure positive contact and adhesion with substrate.
- H. Vertical Applications:
 - 1. For vertical applications, align sheets with an 'inside' or 'outside' corner to avoid wrinkles and misalignment of subsequent applications.
 - 2. Measure and pre-cut into manageable sized fully self-adhered sheets to suit the application conditions.
 - 3. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.
 - 4. Roll up pre-cut material lengths with release paper facing OUTWARD.
 - 5. Starting at a corner of the roll, peel back approx. 6" (152.4 mm) of release paper from across the width of the pre-cut material roll.
 - 6. Using hand pressure, lightly apply the exposed adhesive surface to the substrate.
 - 7. Allow the rolled up material to drop down the wall, with the remainder of the release paper still attached (facing the wall), and extend down to lowest point of wall, checking for proper alignment, repositioning as necessary.
 - 8. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.
 - 9. Align and position fully self-adhered membrane, remove release film and press firmly into place. Provide minimum 3 inch overlap at side and end laps of membrane.
 - 10. Continue to remove release film and apply pressure to ensure positive contact onto wall substrate.
 - 11. Install subsequent sheets of fully self-adhered vapor permeable air barrier sheets in overlapping weatherboard format. Ensure sheets lay smooth and flat to surfaces. Roll membrane and lap seams with roller to ensure contact and adhesion.
 - 12. Refer to manufacturer for the most current and complete installation instructions.
- I. Horizontal Applications:
 - 1. For horizontal applications, align sheets and begin installation of water-resistive weather barrier at bottom or lowest point of wall.
 - 2. To avoid wrinkles and misalignment of subsequent applications, it is recommended to pre-mark or "Snap" a level line to work from.
 - 3. Measure and pre-cut into manageable sized sheets to suit the application conditions.
 - 4. Allow for excess material at bottom of wall to accommodate tie-ins and connections to adjacent surfaces.
 - 5. Align and position fully self-adhered membrane, remove release film and press firmly into place. Provide minimum 3 inch (76.2 mm) overlap at all side and end laps of membrane. Roll membrane and lap seams with roller to ensure contact and adhesion.

6. Continue to remove release film and apply pressure to ensure positive contact onto wall substrate.
 7. Install subsequent sheets of fully self-adhered vapor permeable air barrier sheets in overlapping weatherboard format. Ensure sheets lay smooth and flat to surfaces. Roll membrane and lap seams with roller to ensure contact and adhesion.
 8. Refer to manufacturer for the most current and complete installation instructions.
- J. Seal top of through-wall flashings to air-barrier sheet.
- K. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
- L. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials and as indicated in drawings.
- M. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

3.5 TRANSITION, PENETRATION, AND ACCESSORY MATERIAL INSTALLATION

- A. General: Install flashing, tapes, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition on base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials and as indicated in drawings.
- C. At end of each working day, seal top edge of strips and transition strips to substrate.
- D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant compatible with air barrier membrane and accessories.
- E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Building Transition Conditions:
1. Tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials with self-adhering air barrier transition and flashing membrane.
 2. Align and position fully self-adhered air barrier transition and flashing membrane, remove protective film and press firmly into place. Provide minimum 3 inch (76.2 mm) lap on to substrates.
 3. Ensure minimum 3 inch (76.2 mm) overlap at side and end laps of membrane and 6 inch (152.4 mm) at inside and outside corners.

4. Roll membrane and lap seams with roller to ensure positive contact and adhesion.

G. Mechanical Equipment Penetrations:

1. Mechanical pipe, electrical conduit and/or duct work must be secured solid into position prior to installation of fully self-adhered vapor permeable air barrier membrane.
2. Electrical services penetrating the wall assembly and fully self-adhered vapor permeable air barrier membrane must be placed in appropriate conduit and secured solid into position.
3. Install manufactured flanged penetration sleeves as recommended by sleeve manufacturer.
4. For straight sided penetrations, cut and fit fully self-adhered vapor permeable air barrier to accommodate sleeve, install specified single sided flashing tape to seal the air barrier membrane to ductwork or preformed flange sleeve.
5. For pipe penetrations, refer to manufacturer's standard details.

H. Window, Door and Other Wall Openings:

1. To avoid waste, predetermine best method and sequence to the install fully self-adhered vapor open air barrier transition and flashing membrane around window or wall openings subject to the opening size and installation of window, door or louver type.
2. Install water-resistive vapor permeable transition and flashing membrane: Fully self-adhered air barrier transition and flashing membrane installed 2 ¾ inch (70 mm) into rough wall openings for the sill, jambs and head. It is not required to install continuous sheets through corners.
3. Remove release film, align flashing membrane and apply pressure to ensure positive contact. Roll Lap seams to ensure adhesion. Provide lap seams to shed water.
4. Install vapor permeable water resistive flashing for rough openings.
 - a. Liquid-applied window and door flashing: a liquid-applied vapor permeable air barrier flashing material with vapor permeance and resistance to air leakage properties compatible with the primary air barrier membrane.
 - b. Apply a 12-15 wet mil (0.030-0.038 mm) coating onto the installed flashing, 1 inch (25.4 mm) onto the face continuing into the rough opening, covering the 2 ¾ inch (70 mm) flashing and the exposed rough opening surface.
5. Optional Preformed Window and Door Corners
 - a. Preformed window and door flashing membrane shall be factory formed corners by air barrier manufacturer consisting of 18 inch x 18 inch (457.2 mm x 457.2 mm) preformed 90 degree inside corner membrane with the same vapor permeance and resistance to air leakage physical properties as the primary air barrier membrane.
6. Optional Window Sill Pan
 - a. Subject to window installation requirements, install preformed sill pan system by air barrier manufacturer.
7. Water-resistive Penetration Tapes
 - a. Tapes shall be by air barrier manufacturer: Black, butyl, UV stable, single sided, moisture-resistant flexible tape with adhesive backing having the following properties:
 1. Single-Sided Tape: 2 inch (5.08 cm), 3 inch (7.62 cm) or 4 inch (10.16 cm) wide seam tape.

I. Fastening and Masonry Ties

1. Install clips and masonry ties over primary self-adhered vapor permeable air barrier membrane.
2. Secure clips and masonry ties with corrosion-resistant, or stainless steel screws with gasketed fasteners.
3. Consult manufacturer for recommendations on appropriate masonry tie types and methods to seal penetrations.

3.6 FLEXIBLE FLASHING INSTALLATION

- A. Comply with requirements of Section 042000, "Unit Masonry".

3.7 DRAINAGE

- A. Maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane.

- 1. Maintain continuous open space between furring strips behind cement fiberboard siding and aluminum wall panels.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction, with no fishmouths.
 - 7. Air barrier has been firmly adhered to substrate.
 - 8. Compatible materials have been used.
 - 9. Transitions at changes in direction and structural support at gaps have been provided.
 - 10. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 11. All penetrations have been sealed.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
- D. Make notification when sections of work are complete to allow review prior to covering fully self-adhered water-resistive vapor permeable air barrier system.
- E. Owner to engage independent consultant to observe substrate and membrane installation prior to placement of cladding system(s) and provide written documentation of observations.

3.9 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Protect wall areas covered with self-adhered water-resistive vapor permeable air barrier from damage due to construction activities, high wind conditions, and extended exposure to inclement weather.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than manufacturer's allowable time period, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.

- 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- C. Review condition of fully self-adhered water-resistive vapor permeable air barrier prior to installation of cladding. Repair, or remove and replace damaged sections with new membrane.
- D. Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed fully self-adhered water-resistive vapor permeable air barrier installations.
- E. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.
- F. Remove and replace water-resistive weather barrier membrane affected by chemical spills or surfactants.

END OF SECTION 072500

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SECTION 072610 - UNDER-SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

- A. Products supplied under this section:
 - 1. Vapor barrier, seam tape, and mastic for installation under concrete slabs (basement slab).
- B. Related sections:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for under-slab vapor retarder (first floor slab).
 - 2. Section 07 21 00 "Thermal Insulation" for vapor retarders as part of wall assembly.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E 1745-09 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - 3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
 - 5. ASTM E 1643-09 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. American Concrete Institute (ACI):
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.3 SUBMITTALS

- A. Quality control/assurance:
 - 1. Summary of test results as per paragraph B.3 of ASTM E 1745.
 - 2. Manufacturer's samples, literature.
 - 3. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor barrier must have all of the following qualities:
 - 1. Permeance of less than 0.01 Perms [grains/[ft² · hr · inHg]] as tested in accordance with ASTM E 1745 Section 7.
 - 2. Other performance criteria:
 - a. Strength: ASTM E 1745 Class A.
 - b. Thickness: 15 mils minimum
- B. Vapor barrier products:
 - 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com

2.2 ACCESSORIES

- A. Seam tape:
 - 1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- B. Vapor-proofing mastic:
 - 1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ensure that base material is approved by Architect or Geotechnical Engineer.
 - 1. Level and compact base material.

3.2 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643.
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
 - 2. Lap vapor barrier over footings and/or seal to foundation walls.
 - 3. Overlap joints 6 inches and seal with manufacturer's tape.
 - 4. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 5. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
 - 6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

END OF SECTION 072610

SECTION - 074113 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Standing-seam metal roof panels.
 - 2. Pad-type, flat-mounted snow guards.
- B. Related Sections:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for gutters and downspouts.

1.2 PREINSTALLATION MEETINGS

- 1. Preinstallation Conference: Conduct conference at **Project site**.
 - a. Meet with Architect, metal panel Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - d. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - e. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel, underlayment, and accessory.
 - 2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
 - 3. Manufacturer's details for roof underlayment membrane system showing a continuous plane of water and air tightness over the building enclosure.
 - 4. Include roof plans showing layouts and attachment details of snow guards.
 - a. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.

- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Handling: Use care in unloading; storing, and erecting metal panels to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Store roll materials on end in original packaging. Protect rolls from direct sunlight and inclement weather until ready for use.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and opening dimensions by field measurements before metal panel fabrication, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: **Two years** from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: **20 years** from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: **20 years** from date of Substantial Completion.
- D. Roof Underlayment Warranty: Provide manufacturer's standard material warranty in which manufacturer agrees to provide replacement material for fully self-adhered water-resistive vapor permeable roof underlayment sheets installed in accordance with manufacturer's instructions that fails due to material defects within **20 years** from the date of purchase.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
 1. Roof system shall be equal to **SMACNA FIG 6-5, Pan Method Detail 1, D** or as approved by the Architect.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **MBCI Metal Roof and Wall Systems, SuperLok** or comparable product by one of the following:
 - a. Centria SDP 200
 - b. Firestone UNA-CLAD
 - c. Petersen Aluminum; Tite-Lock Plus
 3. Roof System Design: 1-1/2" high seam formed from interlocking ribs, 12" wide panels; 24 gauge.
 4. Roof Panels: Shall be the maximum possible lengths to minimize endlaps.
 - a. Aluminum-Zinc Alloy-Coated Steel Sheet.
 - b. Surface: Smooth, flat finish.
- C. Concealed Clips: Two-piece floating to accommodate thermal movement. Shall be die punched having both a purlin bearing flange pre-punched to receive manufacturers recommended fastener to withstand design loads and a panel support flange in the configuration of the underlap leg.
 1. Material: Sinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 2. Spacing of clips to accommodate wind-uplift requirements and substrate pullout capacity.
- D. Joint Type: Single folded - typical. Double folded at low slope roof over vestibule and pop-out window.
- E. Finish: All panels shall receive a factory-applied finish. Color selected by Architect from manufacturer's full range of standard colors or as indicated on drawings.
 1. Exposed Coil-Coated Finish:
 - a. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Concealed Finish: White or light-colored acrylic or polyester backer finish.
- F. Provide closures, flashings, sealants, gaskets, fillers, trim, fasteners, gutters and downspouts and clips to ensure a complete system in conformance with the design indicated on the drawings.
 1. All exposed trim and accessories shall be in same color and finish as roof panels. All visible parts shall be in finish color, including interior of gutter if exposed to view.
 2. Fastener screws which protrude through roof sheathing and supports such that they are visible from below, where bottom of roof is exposed to view, shall be aligned and uniformly spaced.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Water-Resistive Vapor Permeable Roof Underlayment Membrane: Provide self-adhering, cold-applied, sheet underlayment consisting of slip-resistant membrane with release-paper backing. Components and accessories shall be obtained from a single-source to ensure system capability and integrity. Provide primer when recommended by underlayment manufacturer
- B. Roof underlayment (Basis of Design): SlopeShield SA by VaproShield or equal.
 - 1. Fully self-adhered water-resistive vapor permeable roof underlayment consisting of multiple layers of UV stabilized spun-bonded polypropylene membrane.
 - a. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - b. UV Stable: UV exposure for 120 days.
 - c. Adhesives: 100% coverage on back side of membrane (not spot applied), vapor permeable.
 - d. Water Vapor Permeance tested to ASTM E398: minimum of 51 perms.
 - e. Water Resistance tested (Ponding): AC48, 24 inches, 48 hours, no leakage.
 - f. Tensile Strength tested to ASTM D5034: 88lbf, machine direction; 83 lbf, cross-machine direction.
 - g. Application Temperature: Ambient temperature must be above 20 degrees F.
 - h. Physical Dimensions: 0.022 inches thick.
 - i. Liquid Water Transmission to ASTM D4869.
 - j. Fastener Pull-through Resistance: ASTM D3462.
- C. Water-Resistive Vapor Permeable Transition and Flashing Membrane (Basis of Design): VaproFlashing SA by VaproShield.
 - 1. Self-adhered underlayment flashing membrane shall be a fully self-adhered vapor permeable water-resistive sheet membrane consisting of multiple layers of UV stabilized spun-bonded polypropylene having properties equal to the primary self-adhered water resistive underlayment membrane.
- D. Penetration Sealant:
 - 1. Provide sealant for penetrations as recommended by manufacturer and as specified under Division 07 Section: Sealants. Appropriate sealants shall be Dow Corning® 758 or VaproLiqui-Flash.
- E. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- [25-mm-] thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Gutters and Downspouts: Install gutters and downspouts to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match **metal roof panels**.
- D. Panel Fasteners: Self-tapping screws, bolts, nuts, and self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads and penetrate through the composite roof panels into metal deck or wood deck (per drawings) and to withstand design loads.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 SNOW GUARDS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
 - a. Temperature Change: **120 deg F ambient; 180 deg F, material surfaces.**
- B. Structural Performance:
 1. Snow Loads: As indicated on Drawings.
- C. Pad-Type Snow Guards
 1. Material: UV Stabilized Polycarbonate
 2. Attachment: Adhesive.
 3. Finish: Clear.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- E. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements within panel assembly.
- F. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrates
- B. All surfaces must be dry, sound, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the fully self-adhered roof underlayment membrane. Fill voids and gaps greater than 7/8 inch [22 mm] in width, in substrate to provide an even surface.
- C. Ensure all preparatory work, including installation of mechanical and electrical penetrations and fixtures are complete and secured in-place prior to applying fully self-adhered roof underlayment membrane.
- D. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
- E. Install roof underlayment membrane, weather barrier flashing, lap seam tapes, metal flashings, ventilation strips, roof finish system complete with clips, metal valley flashings and accessories.
 - 1. Apply over the entire roof surface.
 - 2. Apply over the roof area indicated below:
 - a. Valleys: Double layer as indicated on drawings. Overlap ends of sheets not less than 6 inches.
 - b. Around dormers, chimneys, skylights, and other penetrating elements: As indicated on drawings or for a distance of 18 inches onto/over element.
- F. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- G. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

- C. Proper installation of standing seam roof system is the responsibility of the Contractor.
- D. The Contractor shall inspect structure to insure proper conditions for installation of the roof system.
- E. The system shall be erected in accordance with the manufacturer's recommended installation instructions, which hereby become a part of this specification.
- F. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- G. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- H. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. At end laps of panels, install tape caulk between panels.
 - 4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 5. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- I. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- J. Accessories: Install components required for a complete roof panel system, including trim, ridge closures, clips, flashings, gutters, downspouts, sealants, gaskets, fillers, closure strips, and similar items.
- K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- L. Gutters and Downspouts: Install gutters and downspouts to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."
- M. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- N. After installation, all pre-painted panels and fasteners shall be wiped clean and all scratches or abrasions shall be touched up with an air-dry paint as supplied by the roof panel manufacturer. Touch-up paint shall be the same color as the roof panels.

3.5 ERECTION TOLERANCES

- A. Seams shall align with major grid lines typical. Panels may be adjusted in width to maintain alignment by no more than 1/2".
- B. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 SNOW GUARD INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 - 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
- B. Clean and prepare substrates for bonding snow guards.
- C. Prime substrates according to snow guard manufacturer's written instructions.
- D. Install snow guards according to manufacturer's written instructions. **Space rows as recommended by manufacturer.**
- E. Attachment for Standing-Seam Metal Roofing:
 - 1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.

3.7 CLEANING AND PROTECTION

- A. Protect completed installations of fully self-adhered water-resistive roof underlayment membrane from damage due to extreme weather conditions, physical abuse and other subtrades.
- B. Cover membrane as soon as practical.
- C. Repair damaged water-resistive roof underlayment membrane. Measure and pre-cut roof underlayment membrane to cover damaged area with minimum 12 inch overlap to the sides and bottom. Roll membrane to ensure positive contact. Provide Dow Corning® 758 Weather Barrier Sealant over exposed leading edge of membrane terminations.
- D. Remove and replace roof underlayment membrane affected by chemical spills or surfactants.
- E. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- F. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal plate wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
 - 1. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 2. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 3. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 - 4. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 5. Review temporary protection requirements for metal panel assembly during and after installation.
 - 6. Review procedures for repair of metal panels damaged after installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.
 - 2. Include similar Samples of trim and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical metal panel assembly as shown on Drawings, including supports, attachments, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: **Two** years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: **20** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: **As indicated on Drawings.**
 3. Deflection Limits: For wind loads, no greater than **1/180** of the span.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): **120 deg F ambient; 180 deg F material surfaces.**

2.2 METAL PLATE WALL PANELS

- A. Metal Plate Wall Panels: Provide factory-formed or field-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment assembly components, and accessories required for weathertight system.
- B. Aluminum Sheet: Tension-leveled, smooth aluminum sheet, ASTM B 209 (ASTM B 209M), **0.080 inch** thick.
 1. Exterior Finish: **Clear anodized.**
- C. Attachment Assembly: Wet Seal System Type (as indicated on drawings).

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Subframing and Furring: Wood in depth as indicated on drawings. Provide as required for support and alignment of metal panel system. Provide shims as necessary.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including back plates, trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to,

bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

- D. Panel Fasteners: Exposed, countersunk, self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of factory-applied coating – Stainless Steel or Aluminum. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer. Provide sealant types that are compatible with panel materials, are nonstaining, and do not damage panel finish.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal panel joints with captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards. Provide continuous back plates at joints.
 - 3. Exposed fasteners. Exposed fasteners on faces of accessories exposed to view shall match material, alignment and spacing of panels.
 - 4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes. Locate and space as indicated on drawings.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel joints as indicated on drawings.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Installation: Attach metal plate wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal plate wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
- F. Girt/Furring Installation: Install support assembly at locations, spacings, and with fasteners as indicated in drawings. Use girts / furring that provide continuous support and drainage, draining to the exterior at horizontal joints. Attach metal plate wall panels directly attaching panels to girts / furring with continuous back plates at panel edges. Fully engage girts/furring and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions or flashing as indicated on drawings.
1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- G. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- H. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.
- I. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Remove and replace metal wall panels where inspections indicate that they do not comply with specified requirements.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

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SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes factory-finished fiber-cement **siding** panels, trim, and accessories.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 061200 "Structural Insulated Panels" for wood substrate.
 - 3. Section 072500 "Weather Barriers" for weather-resistive barriers.

1.2 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.[Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.]
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements.
 - 3. Installation methods.
- B. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials, which are outside the scope of the standard details and specifications provided by the manufacturer.
- C. Samples: For fiber-cement **siding** including related accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement **siding**.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 2 percent of amount installed.

1.8 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings including accessories. Verify exact extends of mockup with Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.
- C. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.10 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period:
 - a. 30 years from date of Substantial Completion for vertical siding.

- b. **15 years for trim boards.**
- 3. **Finish Warranty:** Limited product warranty against manufacturing finish defects.
 - a. 15 years from the date of purchase; will not peel; will not crack; and will not chip. Finish warranty shall include the coverage for labor and material.
- 4. **Workmanship Warranty:** Application limited warranty for 2 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Source Limitations:** Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. **General:** ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
 - 1. **HardiePanel Select Cedarmill Vertical Siding** by James Hardie Building Products, Inc. or equal.
 - 2. **HardiTrim Rustic Grain Batten Boards** by James Hardie Building Products, Inc. or equal.
- B. **Labeling:** Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. **Nominal Siding Thickness:** Not less than 5/16 inch (8 mm).
- D. **Batten Boards:** 2-1/2 inch wide by 3/4 inch deep by 12 ft. long boards.
 - 1. **Texture:** **Wood grain texture.**
- E. **Panel Size:** 48-inch wide sheets. Height as indicated on drawings.
- F. **Panel Texture:** **wood-grain texture.**
- G. **Factory Priming:** Manufacturer's standard acrylic primer.

2.3 ACCESSORIES

- A. **Siding Accessories, General:** Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. **Flashing:** Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- C. **Fasteners:**
 - 1. For fastening to wood, use **siding nails** of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.

2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
3. For fastening fiber cement, use **hot-dip galvanized** fasteners.

2.4 FINISHES

- A. Factory Primer: Provide factory applied universal primer.
 1. Primer: Factory primed by manufacturer.
 2. Topcoat: Refer to Section 099113 and Elevation and Building Section Legend.
- B. Factory Finish: Refer to Exterior Finish Schedule.
 1. Product: ColorPlus Technology by James Hardie or equal.
 2. Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.
 3. Process:
 - a. Factory applied finish by fiber cement manufacturer in a controlled environment within the fiber cement manufacturer's own facility utilizing a multi-coat, heat cured finish within one manufacturing process.
 - b. Each finish color must have documented color match to delta E of 0.5 or better between product lines, manufacturing lots or production runs as measured by photo spectrometer and verified by third party.
 4. Protection: Factory applied finish protection such as plastic laminate that is removed once siding is installed.
 5. Accessories: Complete finishing system includes pre-packaged touch-up kit provided by fiber cement manufacturer. Provide quantities as recommended by manufacturer.
- C. Factory Finish Color for Trim, Soffit and Siding Colors.
 1. Iron Gray JH90-30.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement **siding** and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- C. Install a water-resistive barrier.
- D. Verify that the water-resistive barrier is appropriately installed with penetration and junction flashing.
- E. Install water-resistive barriers and claddings to dry surfaces.
- F. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
- G. Protect siding from other trades.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.
- C. Install continuous vertical furring at locations, spacing, and of size specified and as indicated on drawings.
 - 1. 12" O.C. vertically – typical.
 - 2. Joints (and furring) shall align with major structural gridlines and as indicated on drawings.
 - 3. Behind all vertical batten strips, locations as indicated on drawings.
 - 4. Behind panel joints.
- D. Install continuous starter blocking between vertical furring at the bottom of the wall of depth indicated on drawings. Provide 1/4" gaps at either end of blocking to allow for drainage.
- E. Install continuous termination blocking between vertical furring at the top of the wall of depth indicated on drawings. Provide 1/4" gaps at either end of blocking to allow for drainage.
- F. Install continuous blocking between furring where panel siding horizontal joints occur. Provide 1/4" gaps at either end of blocking to allow for drainage.
- G. Install metal Z flashing and provide a 1/4 inch (6 mm) gap at horizontal panel joints.
- H. Install battens at 12" o.c. and as indicated on drawings, unless otherwise noted.
- I. Locate joints in coordination with batten board layout, so as to be concealed behind batten board.
- J. Panel end joints shall be located over furring, with adjoining panels securely attached to furring. Coordinate furring width at panel joints to accommodate attachment.
- K. Face nail panels and batten boards to furring strips. Conceal attachment of panels behind batten board whenever possible.
- L. Place fasteners no closer than 3/8 inch (9.5 mm) from panel edges and 2 inches (51 mm) from panel corners.
- M. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

- N. Maintain clearance between siding and adjacent finished grade.
- O. Specific framing and fastener requirements refer to ICC-ES Evaluation Report No. ESR-1844 unless noted otherwise:
 - 1. Where installed over structurally insulated wall panels, install fasteners at **12 inches** o.c. horizontally and vertically. Verify attachment location and spacing with cement fiber board manufacturer and structurally insulated wall panel manufacturer to meet sheathing pull-out requirements.
- P. Fasten through trim/batten boards into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
- Q. Place fasteners for trim/batten board no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten as indicated on drawings or maximum 16 inches (406 mm) on center.
- R. Trim inside corner with a single board trim both side of corner or as indicated on drawings.
- S. Outside Corner Board Attach Trim on both sides of corner with 16 gage corrosion resistant finish nail 1/2 inch (13 mm) from edge spaced 16 inches (406 mm) apart, weather cut each end spaced minimum 12 inches (305 mm) apart.
- T. Allow 1/8 inch gap between trim and siding.
- U. Seal gap with high quality, paint-able caulk.
- V. Fasten through overlapping boards. Do not nail between lap joints.
- W. Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer's printed instructions.
 - 1. Touch-up nicks, scrapes, and nail heads in pre-finished siding using the manufacturer's touch-up kit pen.
 - 2. Touch-up of nails shall be performed after application, but before plastic protection wrap is removed to prevent spotting of touch-up finish.
 - 3. Use touch-up paint sparingly. If large areas require touch-up, replace the damaged area with new pre-finished siding. Match touch up color to siding color through use of manufacturer's branded touch-up kits.

3.4 FINISHING

- A. Finish unprimed siding with a minimum one coat high quality, alkali resistant primer and one coat of either, 100 percent acrylic or latex or oil based, exterior grade topcoats or two coats high quality alkali resistant 100 percent acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.
- B. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

3.5 PROTECTION

- A. Protect installed products until completion of project.

- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets with counterflashing.
 - 2. Formed roof-drainage sheet metal fabrications.
 - 3. Formed steep-slope roof sheet metal fabrications.
 - 4. Formed equipment support flashing.
 - 5. Formed overhead-piping safety pans.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 6. Include details of termination points and assemblies.
 - 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 - 8. Include details of roof-penetration flashing.

9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
 12. Detail formed flashing and trim at scale of not less than **1-1/2 inches per 12 inches**.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. B rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: **20** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install **roof edge flashings** tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: **As indicated on Drawings.**
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: **120 deg F ambient; 180 deg F material surfaces.**

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with **smooth, flat** surface.
 - 1. As-Milled Finish: **Mill.**
 - 2. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).
 - 3. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - a. Color: **Clear.**
 - b. Color Range: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality
 - 2. Surface: **Smooth, flat.**
 - 3. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
4. Color: **As selected by Architect from manufacturer's full range.**
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.
- E. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D 4397.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, **solder**, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal **or manufactured item** unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal **or manufactured item**.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone **(except with metallic-coated steel)** polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated **with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.**
 - 1. Material: **Aluminum, 0.024 inch thick.**
 - 2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 3. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 5. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 - 6. Finish: Mill.

2.6 FABRICATIDN, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. **Rivet joints where necessary for strength in locations not exposed to view.**
- I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. **Rivet joints where necessary for strength in locations not exposed to view.**
- J. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters (and gargoyles): Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than **twice the gutter thickness**. Fabricate expansion joints, expansion-joint covers, **gutter bead reinforcing bars**, and gutter accessories from same metal as gutters. **Shop fabricate interior and exterior corners.**
 - 1. Gutter Profile: SMACNA Style H with square profile (90 degree corners).
 - 2. Expansion Joints: **Lap type.**
 - 3. Accessories: **Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.**
 - 4. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch thick - 26 GA.**
- B. Downspouts: Fabricate **rectangular downspouts** to dimensions indicated, complete with mitered corners. Furnish with metal hangers from **same material as downspouts and anchors.**
 - 1. Fabricated Hanger Style: **Fig 1-35I** according to SMACNA's "Architectural Sheet Metal Manual."
 - 2. Hanger Style: Standoff - Refer to drawings for standoff dimension in order to maintain vertical downspouts without bends, except at eave.
 - 3. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch thick - 26 GA.**

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates.
 - 1. Joint Style: Overlapped, 4 inches wide.

2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the Following Materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick – 24 GA.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.
 1. Coping Profile: As indicated on drawings.
 2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
 3. Fabricate from the Following Materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: **0.040 inch** thick.
- C. Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.034 inch** thick – 22 GA.
- D. Base Flashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick - 24 GA.
- E. Counterflashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- F. Flashing Receivers: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick – 24 GA.
- H. Roof-Drain Flashing: Fabricate from the following materials:
 1. Zinc-Tin Alloy-Coated Stainless Steel: **0.015 inch** thick.

2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- B. Valley Flashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick – 24 GA.
- C. Drip Edges: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- E. Counterflashing: **Shop fabricate interior and exterior corners.** Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick – 26 GA.
- F. Flashing Receivers: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: **0.022 inch** thick 26 GA.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick – 24 GA.

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: **0.028 inch** thick – 24 GA.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Galvanized Steel: **0.040 inch** thick – 20 GA.
 2. Aluminum-Zinc Alloy-Coated Steel: **0.040 inch** thick 20 GA.
- C. Other Flashings and Trim pieces (including interior locations see drawings)
1. Unbroken face dimension of 6" or less:
 - a. Aluminum: **0.040 inch** thick.
 2. Unbroken face dimension of 6"-12":
 - a. Aluminum: **0.080 inch** thick.
 3. See Drawings for panels of larger dimensions. If gauge or thickness not directly stated, thickness shall be as recommended for brake metal flashing in SMACNA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches

staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

- D. Apply slip sheet, wrinkle free, per manufacturer's instructions before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, **solder**, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of **uncoated-aluminum** sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of **10 feet** with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate
 - 1. Wood blocking or sheathing: not less than **1-1/4 inches** for nails and not less than **3/4 inch** for wood screws. Substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
 - 2. Metal decking: not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50

- percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder **metallic-coated steel and aluminum sheet**.
 2. Do not use torches for soldering.
 3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- H. Rivets: Rivet joints in **uncoated aluminum** where necessary for strength and not exposed to view.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with **riveted and soldered joints**. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
 2. Anchor and loosely lock back edge of gutter to continuous cleat, **eave or apron flashing**.
 3. Anchor gutter with **straps** spaced not more than **24 inches** apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
 4. Install gutter with expansion joints at locations indicated, but not exceeding, **50 feet** apart. Install expansion-joint caps.
 5. Install continuous gutter screens on gutters with noncorrosive fasteners, **removable** for cleaning gutters.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
 2. Provide elbows at base of downspout to direct water away from building.
 3. Connect downspouts to underground drainage system unless otherwise indicated.
- D. Splash Pans: Install where downspouts discharge on **low-slope roofs**. Set in **elastomeric sealant** compatible with the substrate.
- E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and **solder or seal with elastomeric sealant** to scupper.
- F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, **sheet metal manufacturer's written installation instructions**, and SMACNA's "Architectural Sheet Metal

Manual." Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at **staggered 3-inch centers**.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at **24-inch centers**.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at **24-inch centers**.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of **snap-in installation and sealant or lead wedges and sealant; interlocking folded seam or blind rivets and sealant** unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with **elastomeric sealant** and clamp flashing to pipes that penetrate roof.

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion

of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Mildew-resistant joint sealants.
- B. Related Sections:
 - 1. Section 042000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Section 088000 "Glazing" for glazing sealants.
 - 3. Section 092900 "Gypsum Board" for sealing perimeter joints.
 - 4. Section 093100 "Ceramic Tile" for sealing tile joints.

1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- B. Sample warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: **Two** years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: **Twenty** years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
 1. Architectural sealants shall have a VOC content of **250 g/L or less**.
 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of **250 g/L or less**.
 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of **775 g/L or less**.
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- C. Colors of Exposed Joint Sealants: **Selected by Architect**.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Dow Corning Corporation; NS.
- b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 728 NS.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 290 FPS-NB.
 - b. Pecora Corporation; 890FTS/TXTR.
 - c. Tremco Incorporated; Spectrem 1.
- C. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. Sherwin-Williams Company [The].

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; SCS1700 Sanitary.
 - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
 - d. Soudal USA; RTV GP.
 - e. Tremco Incorporated; Tremsil 200.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application

indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.

- B. **Joint Priming:** Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. **Sealant Installation Standard:** Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. **Install sealant backings** of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. **Install bond-breaker tape** behind sealants where sealant backings are not used between sealants and backs of joints.
- E. **Install sealants** using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. **Tooling of Nonsag Sealants:** Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - 4. Provide recessed joint configuration of recess depth and at **locations indicated on Drawings** according to Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. **Clean off excess sealant or sealant smears** adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform **10** tests for the first **1000 feet** of joint length for each kind of sealant and joint substrate.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces **JS-1**.
 - 1. Joint Locations:
 - a. Joints in dimension stone cladding.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: **Silicone, nonstaining, S, NS, 100/50, NT**.
 - 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces **JS-3**.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry, walls and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: **Silicone, S, NS, 25, NT**.
 - 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement **JS-4**.
 - 1. Joint Locations:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - b. Other joints as indicated on Drawings.

2. Joint Sealant: **Silicone, S, NS, 25, NT.**
 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces **JS-5.**
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: **Silicone, mildew resistant, acid curing, S, NS, 25, NT.**
 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**
- E. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces **JS-6.**
1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Sidewalk joints.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: **Silicone, S, NS, 50, T.**
 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**
- F. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion **JS-7.**
1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Sidewalk joints.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: **Silicone, S, NS, 50, T, I.**
 3. Joint-Sealant Color: **As selected by Architect from manufacturer's full range of colors.**

END OF SECTION 079200

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of acoustical joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

1.4 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: **Two** years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Sealant shall have a VOC content of **250 g/L or less**.
 2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and **Concealed** Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
 1. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to

comply with joint-sealant manufacturer's written instructions.

- B. **Joint Priming:** Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. **STC-Rated Assemblies:** Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. **Acoustical Ceiling Areas:** Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
 - 1. Temperature-Rise Limit: Where indicated and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.2 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu (0.704 K x sq. m/W) when tested according to ASTM C 1363.

- 1) Locations: Exterior doors.
3. Vertical Edges for Single-Acting Doors: Square edge.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
8. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.3 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as fully welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
 1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as fully welded unless otherwise indicated.
 3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 4. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
 5. Frames for Borrowed Lights: 0.053-inch- (1.3-mm-) thick steel sheet and same as adjacent door frame.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

2.5 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

2.6 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - 3. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

- F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 2. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes access doors and frames for walls and ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material in specified finish.
- D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.3 QUALITY ASSURANCE

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.
 - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.

1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Factory-Primed Finish: Manufacturer's standard shop primer.
- C. Drywall Beads: 0.0299-inch (0.76-mm) zinc-coated steel sheet to receive joint compound.
- D. Plaster Beads: 0.0299-inch (0.76-mm) zinc-coated steel sheet with flange of expanded metal lath.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis; A Ciera Products Co.
 - 3. Bar-Co, Inc. Div.; Alfab, Inc.
 - 4. Cendrex Inc.
 - 5. Dur-Red Products.
 - 6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
 - 7. Jensen Industries.
 - 8. J. L. Industries, Inc.
 - 9. Karp Associates, Inc.
 - 10. Larsen's Manufacturing Company.
 - 11. MIFAB, Inc.
 - 12. Milcor Inc.
 - 13. Nystrom, Inc.
 - 14. Williams Bros. Corporation of America (The).
- C. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.
 - 1. Locations: [Wall] or [Ceiling] as indicated.
 - 2. Door: Minimum 0.060-inch- [1.5-mm-] thick sheet metal.
 - 3. Frame: Minimum 0.060-inch- [1.5-mm-] thick sheet metal with drywall bead flange.
 - 4. Hinges: Spring-loaded, concealed-pin type.
 - 5. Lock: Mortise cylinder.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view, provide materials with smooth, flat surfaces without blemishes.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08311

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SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Service doors.
 - 2. Fire-rated service doors.
 - 3. Insulated Service doors

1.2 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Show locations of replaceable fusible links.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.
- E. Maintenance Data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
 - 1. Temperature-Rise Limit: provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Curtain Jamb Guides: See plan and section details on drawings and provide Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over-travel of curtain.

2.2 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
 2. Keys: Provide Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.4 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:
 1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
 4. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices.
- D. Weatherseals for Exterior Doors: Equip each exterior door with rubber, neoprene or vinyl bulb-type weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf [111 N].
- C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf [111 N] force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25 lbf [111 N] force to turn crank. Fabricate gearbox to be oil tight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.7 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.
 - 1. Electrical Characteristics:
 - a. See electrical drawings.
 - 2. Motor Type and Controller: Reversible motor and controller [disconnect switch] for motor exposure indicated.
 - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. [203 mm/s] and not more than 12 in./sec. [305 mm/s], without exceeding nameplate ratings or service factor.
 - 4. Operating Controls, Controllers [Disconnect Switches], Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
- D. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
 - 1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using

manufacturer's standard take-up reel or self-coiling cable. Provide self-monitoring capability designed to interface with door operator control circuit to detect damage to or disconnection of sensing device.

- E. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 - 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.8 DOOR ASSEMBLY

- A. Location: Loading Dock
- B. Service Door: Overhead insulated, electric operator coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ACME Rolling Doors.
 - b. Alpine Overhead Doors, Inc.
 - c. AlumaTek, Inc.
 - d. C.H.I. Overhead Doors.
 - e. CityGates.
 - f. Cookson Company.
 - g. Cornell Iron Works, Inc.
 - h. Dynamic Closures Corp.
 - i. Lawrence Roll-Up Doors, Inc.
 - j. Mahon Door Corporation.
 - k. McKeon Rolling Steel Door Company, Inc.
 - l. Metro Door.
 - m. Overhead Door Corporation.
 - n. QMI Security Solutions.
 - o. Raynor.
 - p. Southwestern Steel Rolling Door Co.
 - q. Wayne-Dalton Corp.
 - r. Windsor Door.
- C. Operation Cycles: Not less than 10,000.
- D. Curtain R-Value: **10.9 deg F x h x sq. ft./Btu (Foamed-in-place polyurethane insulation)**
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (38-mm) center-to-center height.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- H. Hood: Match curtain material and finish.

1. Shape: Square.
 2. Mounting: Face of Wall as shown on Drawings.
- I. Locking Devices: Equip door with slide bolt for padlock.
1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.
- A. Electric Door Operator:
1. Usage Classification: Light duty, up to 10 cycles per hour.
 2. Motor Exposure: Interior.
 3. Emergency Manual Operation: Push-up type.
 4. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
- B. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Fire-Rated Doors: Install according to NFPA 80.
- C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- D. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

3.2 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083233

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior and Interior aluminum-framed storefronts.
 - a. Glazing is retained mechanically with gaskets on four sides or by structural sealant at vertical edges and mechanically with gaskets at horizontal edges.
 - 2. Exterior manual-swing aluminum doors.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Thermal stresses transferred to building structure.
 - b. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - c. Glazing-to-glazing contact.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- B. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by aluminum-framed systems without failing adhesively or cohesively. Provide sealant that fails cohesively before sealant releases from substrate when tested for adhesive compatibility with each substrate and joint condition required.
 - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
 - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.
- C. Structural-Sealant Joints: Designed to produce tensile or shear stress in structural-sealant joints of less than 20 psi [138 kPa].
- D. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches [4.1 m] and to 1/240 of clear span plus 1/4 inch [6.35 mm] for spans greater than 13 feet 6 inches [4.1 m] or an amount that restricts edge deflection of individual glazing lites to 3/4 inch [19 mm], whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
- E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity but not less than 10 seconds.
- F. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change [range] in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change [Range]: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. Test High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Test Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Test Interior Ambient-Air Temperature: 75 deg F (24 deg C).
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- H. Water Penetration Under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- I. Water Penetration Under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
1. Maximum Water Leakage: According to AAMA 501.1, no uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- K. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.
- L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having minimum STC 32 according to ASTM E 413 and an OITC 26 according to ASTM E 1332, as determined by testing according to ASTM E 90.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - 3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
 - a. Include structural-sealant-glazing quality-control program development and reporting complying with ASTM C 1401 recommendations including, but not limited to, system material qualification procedures, preconstruction sealant-testing program, and procedures and intervals for system fabrication and installation reviews and checks.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility and adhesion of sealants with each material that will come in contact with sealants and each condition required by aluminum-framed systems.
 - 1. Test a minimum of five samples of each metal, glazing, and other material.
 - 2. Prepare samples using techniques and primers required for installed systems.
 - 3. For materials that fail tests, determine corrective measures required to prepare each material to ensure compatibility with and adhesion of sealants, including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

- E. Accessible Entrances: Comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- F. Structural-Sealant Glazing: Comply with recommendations in ASTM C 1401, "Guide for Structural Sealant Glazing."
- G. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components to function properly.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following products or equivalent products by EFCO, Kawneer, Manko or Architectural Products:
 - 1. Aluminum Storefront System:
 - a. Manko 2450 FS, 2" x 4½" Thermal Storefront System
 - 2. Aluminum Storefront System at all:
 - a. Manko 2450 FS, 2" x 4½" Storefront System
 - 3. Aluminum Entrances:
 - a. Manko Series 350 Medium Stile Doors with the following accessories:
 - 1) Hinges: Pivot
 - 2) Panel: Insulated glass.
 - 4. Operable windows installed in Aluminum Storefront System:

- a. Manko 1100 Series, Project-out installed into storefront

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - 2. Reinforce members as required to receive fastener threads.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type and as follows:
 - 1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system

components with which it comes in contact; and recommended by structural- and weatherseal-sealant and aluminum-framed system manufacturers for this use.

- a. Color: Matching structural sealant.

2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for manual swing operation.
 - 1. Door Construction: 1-3/4-inch [44.5-mm] overall thickness, with minimum 0.125-inch [3.2-mm] thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile; 3 1/2" normal width- typical. Classroom and office doors with lever-type locksets shall have wide stiles with 5" nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
 - 1. Opening-Force Requirements:
 - a. Egress Doors: Not more than 30 lbf (133 N) required to set door in motion and not more than 15 lbf (67 N) required to open door to minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N).
- B. **Scheduled Door Hardware:** Provide door hardware according to the Door Hardware Schedule on the drawings, in **specification section "087100 Door Hardware"**. If additional hardware is required provide manufacturer's standard or as listed below.
- C. Push/Pull Set: ULTRALINE Push/Pull Set.
- D. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- E. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- F. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- G. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).

2.7 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil [0.762-mm] thickness per coat.

2.8 FABRICATION

- A. Form aluminum shapes before finishing.

- B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- D. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
- E. Doors: Reinforce doors as required for installing hardware.
 - 1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- F. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Provide one of the following finishes as shown on the drawings:
 - 1. **Clear Anodic Finish:** AAMA 611, Class I, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure non-movement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight, unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Install components plumb and true in alignment with established lines and grades, without warp or rack.
- E. Install glazing as specified in Division 8 Section "Glazing."
- F. Entrances: Install to produce smooth operation and tight fit at contact points.
 - 1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
 - 2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
 - 3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch (3 mm).

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 - 1. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
 - 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch measured to the leading door edge.

END OF SECTION 084113

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SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure **indicated on Drawings** including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind Loads: As indicated on Drawings.
- D. Structural-Test Performance: Test according to ASTM E 330 as follows:
1. When tested at **150** percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **0.2** percent of span.
 2. Test Durations: **10** seconds.
- E. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch (19 mm), whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or $1/8$ inch (3.2 mm), whichever is smaller.
 3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- F. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa)**.
- G. Energy Performance: Glazed aluminum curtain wall shall have certified and labeled energy performance ratings in accordance with NFRC.

1. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of **0.30 cfm/sq. ft. (1.50 L/s per sq. m)** of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of **6.24 lbf/sq. ft. (300 Pa)**.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data and **structural calculations** signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified Installer and testing agency.
- F. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- G. Product test reports.
- H. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
- C. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
- D. Pre-installation Conference: Conduct conference at **Project site**.

1.5 WARRANTY

- A. Special Assembly Warranty: Standard form in which **manufacturer** agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Five** years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following products or equivalent products by EFCO, MANKO or Vistawall Architectural Products:
 1. Kawneer I 1602 2" system. **Depth shall be 6" overall for 1C type. See frame types and frame elevation sheets.**

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

2.3 FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: **Thermally broken using ISOBAR.**
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, **finished to match framing system.**

- D. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch (25.4 mm)** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
- F. Framing Sealants: Manufacturer's standard sealants.

2.4 GLAZING

- A. Glazing: Comply with Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
 - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of **250 g/L** or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components that, when assembled, have the following characteristics:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Factory-Assembled Frame Units:
 - 1. Rigidly secure nonmovement joints.
 - 2. Seal joints watertight unless otherwise indicated.
 - 3. Install glazing to comply with requirements in Division B Section "Glazing."

- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure non-movement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - 7. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Division 8 Section "Glazing."

3.2 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 084413

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for swinging doors.
 - 2. Electrified door hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Details of electrified door hardware.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- E. Keying Conference: Conduct conference at Owner's designated site to coordinate Owner's keying requirements. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Requirements for access control.
 5. Delivery of keys and permanent cylinders.

1.4 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, with Owner.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.
3. Basis of Design Products: Where Specifications name a product, or refer to a scheduled product and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - a. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents, and that it will produce the indicated results, and that it is compatible with other portions of the Work.
 - b. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements.
 - c. Evidence that proposed product provides specified warranty.
 - d. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - e. Samples, if requested.
4. Product, Manufacturer: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements. Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
5. Owner's Standard: Where Specifications refer to a product or manufacturer as an owner standard, substitutions are not allowed.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
- B. Continuous Hinges: BHMA A156.26; minimum 0.120-inch thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- C. Continuous, Gear-Type Hinges: 6063-T6 Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
1. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by a testing agency acceptable to the authority having jurisdiction.
 2. Provide aluminum geared continuous hinges with factory fabricated cut outs for electrified power transfer where specified.
- D. Basis-of-Design Products: Subject to compliance with requirements, provide scheduled product manufactured by IVES Hardware; Allegion, PLC, (IVE) or a comparable product by:
1. Hager Companies. (HAG)
 2. McKinney Products Company; an ASSA ABLOY Group company. (MCK)
 3. Stanley Commercial Hardware; Div. of The Stanley Works. (STA)

2.3 MECHANICAL LOCKS AND LATCHES

- A. Mortise Locks: BHMA A156.2; Grade 1; Series 1000, tested to meet or exceed 1,000,000 cycles.
- B. Product: Subject to compliance with requirements, provide scheduled products manufactured by Schlage Lock Company; Allegion PLC, (SCH).
- C. Requirements:
 - 1. Latchbolt: Steel with minimum ½" throw deadlatch on keyed and exterior functions; ¾" throw anti-friction latchbolt on pairs of doors.
 - 2. Strikes: Provide manufacturer's standard strike, ANSI curved lip, 1 ¼" x 4 7/8", 16 gauge, with 1" deep box construction, for each lock bolt or latchbolt.

2.4 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Product: Provide factory registered restricted key system.
 - 2. Supplier to verify appropriate keyway prior to ordering locks or cylinders.

2.5 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.2B, Appendix A. New master keyed system. Incorporate decisions made in keying conference.

2.6 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3. Grade 1; except with extended cycle performance testing certified for minimum 8,000,000 cycles; listed by UL for accident and hazard; and conforming to applicable requirements of NFPA 80 and NFPA 101.
 - 1. Product: Subject to compliance with requirements, provide scheduled products manufactured by Von Duprin; Allegion, PLC. (VON).
 - 2. Requirements:
 - a. Internal springs: Coil compression type
 - b. Provide security dead latching for active latch bolts
 - c. Latch Bolts: Self lubricating coating to reduce friction and wear. Plated latchbolts are not acceptable.
 - d. Touch Pad: Stainless steel with return stroke fluid dampers and rubber bottoming dampers.
 - e. Provide filler plates and shim kits as needed for flush mounting of devices on doors.
 - f. Devices with exposed rivets or screws on back of device that would be visible through a glass light are not acceptable.
 - g. Concealed vertical exit devices shall be a cable-actuated concealed vertical latch system. Vertical rods are not acceptable.

2.7 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4 Grade 1; except tested to exceed 10 million (10,000,000) full load operating cycles by an independent test laboratory;
 - 1. Product: Subject to compliance with requirements, provide products manufactured by LCN Closers; Allegion, PLC. (LCN)

- a. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use.
- b. Provide factory-sized rack-and-pinion hydraulic type closers that are adjustable to meet field conditions and requirements for opening force.
- c. Provide closers, constructed with high strength cast iron cylinders, forged main arms, and one piece forged steel pistons, with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm.
- d. Cylinder Body: 1 1/2" piston diameter with 3/4" journal double heat treated shaft, 5/8" full complement bearing, chrome silicon steel spring.
- e. Hydraulic Fluid: ULTRA X™ fluid with constant temperature control from +120°F to -30°F.
- f. Closers with pressure release valves are not acceptable.

2.8 MECHANICAL STOPS AND HOLDOERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product manufactured by IVES Hardware; Allegion, PLC, (IVE) or a comparable product by:
 - a. Hager Companies. (HAG)
 - b. Rockwood Manufacturing Company. (ROC)
- B. Provide door stops for all doors in accordance with the following requirements:
 - 1. Provide convex type wall stops wherever possible.
 - 2. Where wall stops cannot be used, provide floor stops of the proper height.
 - 3. At opening where wall or floor stop cannot be used, provide overhead stop.

2.9 OVERHEAD STOPS AND HOLDOERS

- A. Overhead Stops and Holders: BHMA A156.8.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product manufactured by Glynn-Johnson; Allegion, PLC, (GLY) or comparable product by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc. (ABH)
 - b. Rockwood Manufacturing Company. (ROC)

2.10 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide the scheduled product or comparable product by one of the following:
 - a. Hager Companies. (HAG)
 - b. National Guard Products. (NGP)
 - c. Reese Enterprises, Inc. (REE)
 - d. Zero International. (ZER)

2.11 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide the scheduled product or comparable product by one of the following:
 - a. Hager Companies.
 - b. National Guard Products.
 - c. Reese Enterprises, Inc.
 - d. Zero International.

2.12 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 HARDWARE INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Mounting Heights: Mount door hardware units at heights indicated or as required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- E. Lock Cylinders: Install construction cylinders to secure building and areas during construction period.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

3.3 DDDR HAROWARE SCHEOULE

HW SET NO. 01

FOR USE ON MARK/DOOR #(S):

100A 112A 1188

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HAROWARE	CD-3349A-EO	626	VON
1	EA	PANIC HAROWARE	CD-3349A-NL-OP	626	VON
3	EA	MORTISE CYLINDER	2D-001	626	SCH
1	EA	RIM CYLINDER	2D-022	626	SCH
2	EA	LONG DDOR PULL	9264F 36" 20" STD	630	IVE
2	EA	SURFACE CLDSE	4040XP SCUSH	689	LCN
2	EA	MOUNTING PLATE	404D-18 (IF REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	404D-3D (IF REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	404D-61 (IF REQ'D)	689	LCN
1	EA	DRIP CAP	16A	CL	NGP
2	EA	DOOR SWEEP	101VA	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP
1	EA	NOTE	WEATHERSTRIP BY DDOR MANUF		B/O

DOOR HARDWARE

08710D-7

HW SET NO. 02

FOR USE ON MARK/DOOR #(S):
G100A

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	STORERDOM LOCK	L9080P 07A	626	SCH
2	EA	SURFACE CLOSER	4040XP HCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
1	EA	DRIP CAP	16A	CL	NGP
1	SET	SEALS	700NA	CL	NGP
1	SET	ASTRAGAL	125NA	CL	NGP
2	EA	DOOR SWEEP	101VA	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP

HW SET NO. 03

FOR USE ON MARK/DOOR #(S):
130A

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD	628	IVE
1	EA	PANIC HARDWARE	LD-33A-L-07-299	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	MOUNTING PLATE	4040-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4040-61 (IF REQ'D)	689	LCN
1	EA	DRIP CAP	16A	CL	NGP
1	EA	DOOR SWEEP	101VA	CL	NGP
1	EA	THRESHOLD	896V	AL	NGP
1	EA	NOTE	WEATHERSTRIP BY DOOR MANUF		B/O

HW SET NO. 04

FOR USE ON MARK/DOOR #(S):
100B

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	112HD	628	IVE

DOOR HARDWARE

087100-8

2	EA	PUSH BAR	9100HO-STD	630	IVE
2	EA	LONG DOOR PULL	9264F 36" 20" STD	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	MOUNTING PLATE	4D40-18 (IF REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	4D40-30 (IF REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	4040-61 (IF REQ'D)	689	LCN
2	EA	DOOR SWEEP	601A	CL	NGP
1	EA	NOTE	WEATHERSTRIP BY DOOR MANUF		B/O

HW SET NO. 05

FOR USE ON MARK/DOOR #(S):
118A

Qty		Description	Catalog Number	Finish	Mfr
8	EA	HW HINGE	58B1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	CD-3349A-EO-LBL	626	VON
1	EA	PANIC HARDWARE	CD-3349A-NL-OP-LBL	626	VON
2	EA	MORTISE CYLINDER	20-001	626	SCH
1	EA	RIM CYLINDER	20-022	626	SCH
2	EA	LONG DOOR PULL	9264F 36" 20" STD	630	IVE
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
2	EA	MOUNTING PLATE	4040-18 (IF REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30 (IF REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	4040-61 (IF REQ'D)	689	LCN
2	EA	DOOR SWEEP	601A	CL	NGP
1	EA	GASKET	BY DOOR/FRAME MANUF		B/O

HW SET NO. 06

FOR USE ON MARK/DOOR #(S):
114A 114B

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HW HINGE	58B1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	CD-33A-NL-OP	626	VON
1	EA	MORTISE CYLINDER	20-001	626	SCH
1	EA	RIM CYLINDER	20-022	626	SCH
1	EA	LONG DOOR PULL	9264F 36" 20" STD	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	MOUNTING PLATE	4040-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4040-61 (IF REQ'D)	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	DOOR SWEEP	601A	CL	NGP
1	EA	GASKET	BY DOOR/FRAME MANUF		B/O

HW SET NO. 07

FOR USE ON MARK/DOOR #(S):

DOOR HARDWARE

087100-9

116A

117A

125A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080P 07A	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 08

FOR USE ON MARK/DOOR #(S):

106A

113A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080P 07A	626	SCH
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LOW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 08A

FOR USE ON MARK/DOOR #(S):

110A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	INVISIBLE HINGE	218	626	SOS
1	EA	STOREROOM LOCK	L9080P (LESS OUTSIDE LEVER) 07A L283-150	626	SCH
1	EA	FLUSH PULL	960	626	IVE
1	EA	SURFACE CLOSER	4040XP HCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LOW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 09

FOR USE ON MARK/DOOR #(S):

G100B

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080P 07A	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA	689	LCN

DOOR HARDWARE

087100 - 10

1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET NO. 10

FOR USE ON MARK/DOOR #(S):
109A

Qty		Description	Catalog Number	Finish	Mfr
6	EA	INVISIBLE HINGE	218	626	SOS
2	EA	MANUAL FLUSH BOLT	FB45B	626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	STOREROOM LOCK	L9080P (LESS OUTSIDE LEVER) 07A L283-150	626	SCH
1	EA	FLUSH PULL	960	626	IVE
1	EA	OH STOP	90S	630	GLY
			(LHR LEAF)		
1	EA	SURFACE CLOSER	4040XP HCUSH	689	LCN
			(RHR LEAF)		
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	5020B	BRN	NGP

HW SET NO. 11

FOR USE ON MARK/DOOR #(S):
119A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070P 07A	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 12

FOR USE ON MARK/DOOR #(S):
115A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070P 07A	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	DODR BOTTOM	220NA	CL	NGP
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 13

FOR USE ON MARK/DOOR #(S):
121A

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	NARROW MORTISE LOCK BODY	8556	626	ACC
1	EA	TRIM ONLY	L9070 X 07A (LESS LOCK CASE)	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	SCH
1	EA	SURFACE CLOSER	404DXP EDA	689	LCN
1	EA	MOUNTING PLATE	4040-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4040-61 (IF REQ'D)	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKET	BY DOOR/FRAME MANUF		B/O

HW SET NO. 14

FOR USE ON MARK/DOOR #(S):
126A 127A 128A

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	NARROW MORTISE LOCK BODY	8548	626	ACC
1	EA	TRIM ONLY	L9050 X 07A (LESS LOCK CASE)	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKET	BY DOOR/FRAME MANUF		B/O

HW SET NO. 15

FOR USE ON MARK/DOOR #(S):
1208

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050P 07A	626	SCH
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	EA	DOOR BOTTOM	220NA	CL	NGP

HW SET NO. 16

FOR USE ON MARK/DOOR #(S):
122A 123A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 07A L583-363	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 17

FOR USE ON MARK/DOOR #(S):
120A

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 07A	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	EA	DOOR BOTTOM	220NA	CL	NGP

HW SET NO. 18

FOR USE ON MARK/DOOR #(S):
107A 107B 108A 108B

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8305 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LOW B4E	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET NO. 19

FOR USE ON MARK/DOOR #(S):
129A 129B

Qty		Description	Catalog Number	Finish	Mfr
1	EA	BYPASS TRACK & HDWE	111SD X SIZE REQ'D	AL	JOH
2	EA	FLUSH PULL	919	626	IVE

HW SET NO. 20

FOR USE ON MARK/DODR #(S):
109B

ALL HARDWARE BY DOOR MANUFACTURER.

END OF SECTION 08 71 00

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Interior borrowed lites.
 - 4. Storefront framing.
 - 5. Curtainwall framing

1.2 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated on drawings.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60-seconds or less.

- c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.
 - 1) For monolithic-glass lites heat-treated to resist wind loads.
 - 2) For insulating glass.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
- 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass and of 12-inch- (300-mm-) long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
 - 1. Each color of tinted float glass.
 - 2. Each type and pattern of translucent film.
 - 3. Ceramic-coated spandrel glass.
 - 4. Wired glass.
 - 5. Insulating glass for each designation indicated.
 - 6. For each color (except black) of exposed glazing sealant indicated.
- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Warranties: Special warranties specified in this Section.
- E. Qualification Data: For professional engineer. (For Slope Glazing Assembly units, see Sloped Glazing Assembly section)

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a

record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

- B. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- C. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
- D. Glazing for Fire-Rated Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 4. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
 5. Provide diffuse (satin) glass at clerestory locations in locker rooms and weight room.
- C. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.
- D. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:
 1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
 2. Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
 - a. Manufacturer's standard opacifier material.
- E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
 1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 4. Sealing System: Dual seal, with primary and secondary sealants as follows:

- a. Manufacturer's standard sealants.
- 5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish.
 - b. Desiccant: Molecular sieve or silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.

2.3 GLAZING GASKETS

- A. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene.
 - 2. EPDM.
 - 3. Silicone.
 - 4. Thermoplastic polyolefin rubber.
 - 5. Any material indicated above.
- B. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants, suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 - 1. Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of B5, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type D (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.8 MONOLITHIC FLOAT-GLASS UNITS

- A. Class 1 (clear) annealed or Kind HS (heat strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements, or Kind FT (fully tempered) float glass as required or indicated on the drawings.
 - 1. Uncoated Clear Float-Glass Units MG-1:
 - a. Thickness: 1/4" (6.0 mm), typical.
 - b. Thickness: 3/8" (10.0 mm) where required to reduce deflection.
 - c. Thickness: 1/2" (12.0 mm) at butt-glazed corners and where exposed to direct contact.
 - 2. Uncoated Diffuse (Satin) Float-Glass Units MG-2:
 - a. Thickness: 1/4" (6.0 mm), typical.
 - 3. Coated Clear Float-Glass Units MG-4:
 - a. Thickness: 6.0 mm.
 - b. Reflective Coating: Pyrolytic.
 - c. Color: Neutral (clear).

2.9 INSULATING-GLASS UNITS

- A. Glass Type G1: Monolithic, clear float glass.
 - 1. Location: Interior.
 - 2. Thickness: 1/4 inch (6 mm).
 - 3. Glass: Clear float glass; provide fully tempered where indicated on drawings.
 - 4. Provide safety glazing labeling where drawings indicate fully tempered glazing.
- B. Glass Type G2: Spectrally Selective Low-E coated clear insulating glass.
 - 1. Location: South (All).
 - 2. Product: PPG Solarban 70XL (#2 surface) clear (or equal).

3. Overall Unit Thickness: 1 inch (25 mm).
4. Thickness of Each Glass Lite: 6.0 mm.
5. Outdoor Lite: Clear float glass; provide fully tempered where indicated on drawings.
6. Interspace Content: **Air**.
7. Indoor Lite: Clear float glass; provide fully tempered where indicated on drawings.
8. Transmittance Visible: **64%**.
9. Winter Nighttime U-Factor: **0.28 maximum**.
10. Shading Coefficient: **0.32**.
11. Solar Heat Gain Coefficient: **0.27**.
12. Provide safety glazing labeling where drawings indicate fully tempered glazing.

C. Glass Type **G3**: Low-E coated clear insulating glass.

1. Location: **North (all)**
2. Product: **PPG Sungate 500 (2) clear**.
3. Overall Unit Thickness: 1 inch (25 mm).
4. Thickness of Each Glass Lite: 6.0 mm.
5. Outdoor Lite: Clear float glass; provide fully tempered where indicated on drawings.
6. Interspace Content: **Argon**.
7. Indoor Lite: Clear float glass; provide fully tempered where indicated on drawings
8. Transmittance Visible: **74%**.
9. Winter Nighttime U-Factor: **0.31 maximum**.
10. Summer Daytime U-Factor: **0.31 maximum**.
11. Shading Coefficient: **0.71**.
12. Solar Heat Gain Coefficient: **0.62**.
13. Provide safety glazing labeling where drawings indicate fully tempered glazing.

D. Glass Type **G4**: Low-E coated clear insulating glass. (make g4)

1. Location: **East, West (all)**
2. Product: **PPG Solarban 60 (#2 surface) clear** (or equal).
3. Overall Unit Thickness: 1 inch (25 mm).
4. Thickness of Each Glass Lite: 6.0 mm.
5. Outdoor Lite: Clear float glass; provide fully tempered where indicated on drawings.
6. Interspace Content: **Argon**.
7. Indoor Lite: Clear float glass; provide fully tempered where indicated on drawings
8. Transmittance Visible: **70%**.
9. Winter Nighttime U-Factor: **0.24 maximum**.
10. Shading Coefficient: **0.44**.
11. Solar Heat Gain Coefficient: **0.39**.
12. Provide safety glazing labeling where drawings indicate fully tempered glazing.

E. Glass Type **G5**: Ceramic-Coated insulated spandrel glass.

1. Location: **Per Drawings**
2. Product: **Per Glass Type G1 or G2**.
3. Overall Unit Thickness: 1 inch (25 mm).
4. Thickness of Each Glass Lite: 6.0 mm.
5. Outdoor Lite: Clear float glass; provide fully tempered where indicated on drawings.
6. Interspace Content: **Per Glass Type G1 or G2**.
7. Indoor Lite: Ceramic enamel frit (#3 surface) on clear float glass; provide fully tempered where indicated on drawings
8. Color: **White**
9. Provide safety glazing labeling where drawings indicate fully tempered glazing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep system.
 3. Minimum required face or edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Film-backed glass mirrors qualifying as safety glazing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- C. Samples:
 - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
 - 2. Mirror Clips: Full size.
 - 3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

- A. Preconstruction test reports.
- B. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Glazing Publications: Comply with GANA's "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- B. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
- C. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that have deteriorated within the specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arch Aluminum & Glass Co., Inc.
 - b. Avalon Glass and Mirror Company.
 - c. Binswanger Mirror; a division of Vitro America, Inc.
 - d. D & W Incorporated
 - e. Donisi Mirror Company.
 - f. Gardner Glass, Inc.
 - g. Gilded Mirrors, Inc.
 - h. Guardian Industries.
 - i. Head West.
 - j. Independent Mirror Industries, Inc.
 - k. Lenoir Mirror Company.
 - l. Maran-Wurzell Glass & Mirror.
 - m. National Glass Industries.
 - n. Stroupe Mirror Co., Inc.
 - o. Sunshine Mirror; Westshore Glass Corp.
 - p. Virginia Mirror Company, Inc.
 - q. Walker Glass Co., Ltd.
- B. Clear Glass: Mirror Glazing Quality; ultraclear float glass with a minimum 91 percent visible light transmission.
 - 1. Nominal Thickness: **4.0 mm**
- C. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 104B for Kind FT, Condition A, tempered float glass before silver coating is applied.
 - 1. Nominal Thickness: **4.0 mm**

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of B5, plus or minus 5.
- B. Edge Sealer: Approved by mirror manufacturer.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.
 - 1. Adhesive shall have a VOC content of not more than **70 g/L** when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

- A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation.
 1. Ceramic tile locations: **Recess mount** flush with face of tile.

2.4 FABRICATION

- A. Cutouts: Fabricate cutouts **before tempering** for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- B. Mirror Edge Treatment: **Flat polished**. Seal edges of mirrors with edge sealer.
- C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
 1. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
 2. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.
- B. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.
- C. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- D. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors. **Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.**
- E. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- F. Do not permit edges of mirrors to be exposed to standing water.
- G. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- H. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
 - 2. Exterior gypsum board for ceilings and soffits.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
- B. Regular Type:
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- C. Type X:
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
- D. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.
- E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 3.
 - 1. Core: 5/8 inch Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 1D as rated according to ASTM D 3274.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C 931/C 931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.
 - 1. Core: 5/8 inch (15.9 mm), Type X.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet. **NO PLASTIC TRIM IS ALLOWED.**
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: NOT ALLOWED.
 - e. Expansion (control) joint.
- B. Exterior Trim: ASTM C 1047.
 - 1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc. **NO PLASTIC TRIM IS ALLOWED.**
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Exterior Applications:
 - 1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch [0.84 to 2.84 mm] thick.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Thermal Insulation: As specified in Division 7 Section "Thermal Insulation."
- E. Vapor Retarder: As specified in Division 7 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a tight contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Regular Type: Horizontal and Vertical surfaces, unless otherwise indicated.
 - 2. Type X: As indicated on Drawings or Where required for fire-resistance-rated assembly.
 - 3. Moisture- and Mold-Resistant Type: At wet areas not indicated to receive tile and where otherwise indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions. **NO PLASTIC TRIMS ARE ALLOWED.**
- B. Control Joints: Install control joints at locations indicated on Drawings. Where not indicated on drawings, install according to ASTM C 840 or 20' max o.c. and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated.
 4. U-Bead: Not Allowed.
- D. Exterior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093100 - CERAMIC TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile.
 - 2. Tile backing panels.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.

1.3 EXTRA MATERIALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.
 - 1. Tile and Trim Units: [Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.]

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

- A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. Tile Type: **Glazed wall tile**
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Daltile 3" x 6" ceramic tile in semi-gloss finish, See Drawings for color.**
 - 2. Grout Color: **As selected by Architect from manufacturer's full range.**
 - 3. Mounting: Factory, back mounted.
 - 4. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and **matching characteristics of adjoining flat tile.** Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. **Bullnose: One or two finished edges as required, module size 3" x 6" inches.**

2.2 TILE BACKING PANELS

- A. See Drawings or if no materials specified use Cementitious.

B. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
2. Thickness: **1/2 inch (12.7 mm).**

2.3 SETTING MATERIALS

A. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.

2.4 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Minerals & Chemicals, Inc.
 - b. Boiardi Products; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Mer-Kote Products, Inc.
 - k. Southern Grouts & Mortars, Inc.
 - l. Summitville Tiles, Inc.
 - m. TEC; a subsidiary of H. B. Fuller Company.

2.5 ELASTOMERIC SEALANTS

- A. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, D; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.**
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
- b. Dow Corning Corporation; Dow Corning 786.
- c. GE Silicones, a division of GE Specialty Materials; Sanitary 1700.
- d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
- e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
- f. Tremco Incorporated; Tremsil 600 White.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

3.2 PREPARATION

- A. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- B. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
 - 2. Glazed Wall Tile: 1/16 inch (1.6 mm).

- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- G. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- H. Grout Sealer: Apply grout sealer to **cementitious** grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- I. Install **cementitious backer units** and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 093100

SECTION 095100 - CEMENTITIOUS WOOD-FIBER CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cementitious wood fiber plank acoustical ceiling system
- B. Related Sections:
 - 1. Division 9 Sections: Acoustical Tile Ceiling.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C635 Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E1264 Standard Classification for Acoustical Ceiling Products.
- B. Ceilings and Interior Systems Construction Association (CISCA):
 - 1. CISCA Code of Practices.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Provide acoustical ceiling assembly designed and tested to provide surface burning characteristics (ASTM E84) as follows:
 - a. Flamespread: 0.
 - b. Smoke Developed: 0.
 - 2. Provide acoustical ceiling system which has been manufactured, fabricated and installed to provide Noise Reduction Coefficient (NRC) rating as follows:
 - a. NRC .40

1.4 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product data and installation instructions.
- C. Samples: Submit selection and verification samples: 6 inch x 6 inch (152 x 152 mm) sample for each wood fiber ceiling unit required, showing full range of exposed texture to be expected in completed work.
- D. Quality Assurance/Control Submittals: Submit the following:

1. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.
- B. Regulatory Requirements and Approvals: Comply with requirements below.
 1. International Code Council (ICC):
 - a. ICC-ES Evaluation Report ESR-1112.
 2. State of California:
 - a. DSA Number PA-008.
 3. Underwriters' Laboratories of Canada (ULC) label.
 - a. Structural Cement-Fiber Unit-535X

1.6 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 1. Provide labels indicating brand name, style, size and thickness.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 1. Prevent soiling, physical damage or wetting.
 2. Store cartons open at each end to stabilize moisture content and temperature.

1.7 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
 1. Do not install ceiling panels until building is closed in and HVAC system is operational.
 2. Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
 3. Maintain the following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:
 - a. Relative Humidity: 65 - 75%.
 - b. Uniform Temperature: 55 - 70 degrees F (13 - 21 degrees C).

1.8 MAINTENANCE

- A. Extra Materials: Provide a recommended percentage of 5% additional material for use by owner in building maintenance and repair.
- B. Provide new unopened cartons of extra materials, packaged with protective covering for storage and identified with appropriate labels.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING SYSTEM

- A. Manufacturer: Tectum Inc.
 - 1. Contact: 105 South Sixth Street, Newark, OH 43055; Telephone: (888) 977-9691, (740) 345-9691; Fax: (800) 832-8869; E-mail: info@tectum.com; website: www.tectum.com.
- B. Proprietary Systems. Acoustical ceiling systems, including the following:
 - 1. Tectum Bevel/Bevel Direct Attachment Panels:
 - a. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - b. Thickness: 1 inch (25.4 mm)
 - c. Length: 4' up to 8' available
 - d. Width: 23 inches or 47 inches available
 - e. Color: Natural or Factory painted white.
 - f. Mounting Style: "A".

2.2 ACCESSORIES

- A. Provide accessories as follows:
 - 1. Tectum Painted Head Drywall Screws:
 - a. Material: Steel.
 - b. Length: 1 5/8 inches (41 mm)
 - c. Color: Natural or Factory painted white
 - 2. Tectum Touch-Up Paint:
 - a. Color: Natural or White.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the ceiling system manufacturer.

- B. Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work.
 - 1. Comply with CISCA Code of Practices.

3.2 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Examine surfaces scheduled to receive suspended or directly attached acoustical units for unevenness, irregularities and dampness that would affect quality and execution of work.
 - 2. Do not proceed with installation of ceiling system until unacceptable conditions are corrected.

3.3 INSTALLATION

- A. General: Do not begin installation until materials sufficient to complete an entire room are received and prepared for installation.
- B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders.
- C. Supports to accept screws no greater than 24" o.c. Supports to run perpendicular to panel direction.
- D. Panel ends must fall over support. Panel ends are to be staggered.
- E. Screwed to supports, three screws per panel width for 23" panels and five screws per panel width for 47" panels.
- F. Screw head to be flush with panel surface.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical ceilings, trim, edge moldings and suspension members to comply with manufacturer's instructions for cleaning.
- B. Touch up any minor finish damage.
- C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION 095100

SECTION 095120 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical tiles for ceilings and the following:
 - 1. Concealed suspension systems.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
 - 2. Concealed Suspension System Members: 12-inch- (300-mm-) long Sample of each type.
- C. Maintenance Data: For finishes to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Acoustical Ceiling Tile: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system through one source from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

1.6 COORDINATION

- A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILES, GENERAL

- A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches [400 mm] away from test surface per ASTM E 795.
- B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING

- A. Products: Subject to compliance with requirements, provide the following products or provide equivalent products by The Celotex Corporation or USG Interiors, Inc.:
 - 1. Ceiling **C9A** (as indicated on drawings): Armstrong World Industries, Inc.; 1728 "Fine Fissured Square" Lay-in with 15/16" exposed grid.
 - a. Color: White.
 - b. Texture: Medium.
 - c. LR: Not less than 0.85.
 - d. NRC: Not less than 0.55.
 - e. CAC: Not less than 33.
 - f. Edge/Joint Detail: Square Edge.
 - g. Thickness: 5/8 inch [15 mm].
 - h. Modular Size: 24 by 24 inches, or as indicated on the drawings.
 - i. ASTM Classification: Type III, mineral base with painted finish; Form 2, water felted; Pattern C E.
 - 2. Ceiling **C9B** (as indicated on drawings): Armstrong World Industries, Inc.; 1910 "Ultima" Square Lay-in with 15/16" exposed grid. [scrubbable].
 - a. Color: White.
 - b. Texture: Fine.
 - c. LR: Not less than 0.90.
 - d. NRC: Not less than 0.70.
 - e. CAC: Not less than 35.
 - f. Edge/Joint Detail: Square Edge.
 - g. Thickness: 3/4 inch [15 mm].
 - h. Modular Size: 24 by 24 inches, or as indicated on the drawings.
 - i. ASTM Classification: Type IV, mineral base with painted finish; Form 2, water felted; Pattern E.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- [2.69-mm]- diameter wire.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING

- A. Products: Subject to compliance with requirements, provide the following products or provide equivalent products by The Celotex Corporation or Armstrong World Industries, Inc.:
 - 1. USG Interiors, Inc.; 15/16" Exposed Tee.
- B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 (Z90) coating designation.
 - 1. Structural Classification: Intermediate-duty system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, SUSPENDED ACOUSTICAL TILE CEILINGS

- A. General: Install acoustical tile ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 6. Do not attach hangers to steel deck tabs.
 7. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
 2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches (305 mm) o.c.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095120

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Flooring Transitions and accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.4 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products from Johnsonite or Roppe Corporation.

2.2 COLORS AND PATTERNS

- A. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 RESILIENT MOLDING ACCESSORY

- A. Description: Reducer strip for resilient floor covering and Joiner for tile and carpet at all available locations.
- B. Material: Vinyl.
- C. Profile and Dimensions: As required, provide "slimline" type where available.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms end areas where base is required. Do not install wall base on exposed steel columns or exposed stone and brick walls.

- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION D96513

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SECTION 096813 - CARPET TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes modular, tufted carpet tile.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Existing flooring materials to remain.
 - 3. Carpet tile type, color, and dye lot.
 - 4. Type of subfloor.
 - 5. Type of installation.
 - 6. Pattern of installation.
 - 7. Pattern type, location, and direction.
 - 8. Pile direction.
 - 9. Type, color, and location of insets and borders.
 - 10. Type, color, and location of edge, transition, and other accessory strips.
 - 11. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

- B. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

- 1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, dimensional stability, excess static discharge, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Products: Subject to compliance with requirements, provide products indicated on the Drawings:

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. For wood subfloors, verify the following:
 - 1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.
 - 2. Repair or replace damaged or defective underlayment surface sufficiently to ensure to proper installation of carpet tiles per manufacturer's recommendations.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.
- E. Measure each space to receive carpeting prior to cutting, as a basis of supplying, cutting, and seaming the carpet. The Contractor will be responsible for making all necessary measurements and verifying field conditions prior to commencing any work. The Contractor will be responsible for field verifying the exact location of any floor boxes that will require special cutting or carpet covers. The Contractor will not be allowed extra compensation for any error or omission. The contract documents show or illustrate the design intent, and do not necessarily show all work to be performed.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue-down; install every perimeter tile around all edges of carpeted area with releasable adhesive. At interior tiles install with manufacturer's standard releasable adhesive strips or dots or per manufacturer's recommendations.
- C. For carpet to be installed vertically on walls, patch wall with compound to smooth surface and glue all tiles with contact cement per manufacturer's recommendations. For carpet to be installed vertically on drywall, skim coat surface to level 5 finish and glue all tiles with contact cement per manufacturer's recommendations.
- D. Maintain dye lot integrity. Do not mix dye lots in same area.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings. Layout carpet in order to notch into doorways where possible, minimizing isolated carpet fill in doorways.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders and as indicated in the drawings. Verify pattern with Architect prior to installation.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09681

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Shop-primed steel substrates.
 - 2. Galvanized metal (where noted to be painted).
 - 3. Exterior gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Co.
 - 2. ChemRex.
 - 3. Coronado Paint.
 - 4. Oel Technical Coatings.
 - 5. Kryton Canada Corporation.
 - 6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
- B. Cementitious Galvanized-Metal Primer: MPI #26.

2.4 EXTERIOR LATEX PAINTS

- A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).

2.5 EXTERIOR ALKYO PAINTS

- A. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

Exterior Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
- B. Galvanized-Metal Substrates (only where noted to be painted, typically galvanized finish will be exposed):
 - 1. Alkyd System: MPI EXT 5.3B.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
- C. Exterior Gypsum Board Substrates: (Provide Direct Applied Exterior Finish System on Glass-mat Faced Gypsum)
 - 1. Latex System: MPI EXT 9.2A.
 - a. Prime Coat: Exterior latex matching topcoat.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex (flat).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete (typically sealed only, paint only where noted in drawings.)
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run [batch mix] as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Co.
 - 2. Coronado Paint.
 - 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.

2.4 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.

2.5 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.

2.6 LATEX PAINTS

- A. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).

- B. Interior Latex [Semigloss]: MPI #54 [Gloss Level 5].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Masonry (Clay and CMU): 12 percent.
 - 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
 - C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 - D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - d. Exposed conduit and junction boxes.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 1. Latex System: MPI INT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Topcoat: Interior latex (eggshell).

B. Steel Substrates:

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

- a. Prime Coat: Alkyd anticorrosive metal primer.
- b. Intermediate Coat: Interior latex matching topcoat.
- c. Topcoat: Interior latex (semigloss).

C. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

- a. Prime Coat: Interior latex primer/sealer matching topcoat.
- b. Topcoat: Interior latex (eggshell).

END OF SECTION 099123

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SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes on the following substrates:
 - 1. Exterior Substrates:
 - a. Exposed glued-laminated beams.
 - b. Dressed lumber (finish carpentry or woodwork).
 - 2. Interior Substrates:
 - a. Exposed glued-laminated beams.
 - b. Dressed lumber (finish carpentry or woodwork).

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of finish system and in each color and gloss of finish required.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Co.
 - 2. Coronado Paint.
 - 3. Sherwin-Williams Company (The).
- B. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in wood finish systems schedules or comparable products by one of the following:
 - 1. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction(**and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base**).
 - 1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - 2. Shellacs, Clear: VOC not more than 730 g/L.
 - 3. Stains: VOC not more than 250 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
- D. Low-Emitting Materials: Interior stains and finishes shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Stain Colors: **As selected by Architect from manufacturer's full range.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: **10** percent, when measured with an electronic moisture meter.

- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood Substrates: **laminated beams.**
 - 1. Varnish System **MPI EXT 6.1D (semi gloss):**
 - a. Prime Coat: Varnish matching topcoat.
 - b. First Intermediate Coat: Varnish matching topcoat.
 - c. Second Intermediate Coat: Varnish matching topcoat.
 - d. Topcoat: solvent based, two-component, aliphatic polyurethane clear coating, exterior, MPI Gloss Level 6 (traditional gloss), **MPI #78.**

B. Wood Substrates: wood tongue and groove planks at soffit.

1. Varnish System MPI EXT 6.3F:

- a. Prime Coat: Varnish matching topcoat.
- b. First Intermediate Coat: Varnish matching topcoat.
- c. Second Intermediate Coat: Varnish matching topcoat.
- d. Topcoat: Varnish, water based urethane, MPI Gloss Level 4 (satin-finish), **MPI #194.**

3.6 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

A. Wood Substrates: laminated beams.

1. Clear, Two-Component Polyurethane System MPI INT 6.1W:

- a. Prime Coat: Two-component polyurethane matching topcoat.
- b. Intermediate Coat: Two-component polyurethane matching topcoat.
- c. Topcoat: Varnish, water based urethane, (MPI Gloss Level 4), **MPI #194.**

B. Wood Substrates: wood tongue and groove planks on walls.

1. Polyurethane Varnish System MPI INT 6.4J (gloss level 4):

- a. Prime Coat: Polyurethane varnish matching topcoat.
- b. Intermediate Coat: Polyurethane varnish matching topcoat.
- c. Topcoat: Varnish, interior, polyurethane, oil modified, satin MPI Gloss Level 4, **MPI #57.**

END OF SECTION 099300

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Steel.
 - b. Galvanized metal.
 - c. Aluminum (not anodized or otherwise coated).
 - 2. Interior Substrates:
 - a. Steel.
 - b. Galvanized metal.
 - c. Aluminum (not anodized or otherwise coated).

1.2 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples: For each type of coating system and in each color and gloss of topcoat indicated.
- C. Product List: For each product indicated, include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Bennette Paint Mfg. Co., Inc.
4. Betone! Ltd.
5. BLP Mobile Paint Manufacturing Company, Inc.
6. Cloverdale Paint.
7. Color Wheel Paints & Coatings.
8. Columbia Paint & Coatings.
9. Conco Paints.
10. Coronado Paint.
11. Diamond Vogel Paints.
12. Dunn-Edwards Corporation.
13. Duron, Inc.
14. Euclid Chemical Company.
15. Farrell-Calhoun.
16. Frazee Paint.
17. General Paint.
18. Hirshfield's, Inc.
19. ICI Paints.
20. ICI Paints (Canada).
21. Ins!x.
22. Kelly-Moore Paints.
23. Kwal Paint.
24. M.A.B. Paints.
25. Microblend Technologies Inc.
26. Miller Paint.
27. Mills Paint.
28. PARA Paints.
29. Parex LaHabra Inc.
30. Parker Paint Mfg. Co. Inc.
31. PPG Architectural Finishes, Inc.
32. Pratt & Lambert.
33. Rodda Paint Co.
34. Scott Paint.
35. Sherwin-Williams Company (The).
36. Sico, Inc.
37. Vista Paint.
38. Zinsser.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 3. Provide products of same manufacturer for each coat in a coating system.
- C. Colors: Custom matching Architect's sample.

2.3 INTERIOR PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: [MPI #50.]

2.4 METAL PRIMERS

- A. Primer, Zinc-Rich, Inorganic:[**MPI #19.**]
- B. Primer, Zinc-Rich, Epoxy:[**MPI #20.**]
- C. Primer, Rust-Inhibitive, Water Based:[**MPI #107.**]
- D. Primer, Epoxy, Anti-Corrosive, for Metal:[**MPI #101.**]

2.5 POLYURETHANE COATINGS

- A. Polyurethane, Two-Component, Pigmented, Gloss [Gloss Level 6]:[**MPI #72.**]
- B. Varnish, Aliphatic Polyurethane, Two-Component [Gloss Level 6 or 7]:[**MPI #78.**]

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Concrete Substrates, Vertical Surfaces:
- B. Steel Substrates:
 - 1. Pigmented Polyurethane over Epoxy System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
 - 2. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, epoxy[MPI #20].
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
- C. Galvanized-Metal Substrates:
 - 1. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
 - 2. Pigmented Polyurethane over Vinyl Wash and Epoxy Primer System:
 - a. Prime Coat: Primer, vinyl wash[MPI #80].
 - b. Intermediate Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
- D. Aluminum [Not Anodized or Otherwise Coated] Substrates:
 - 1. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, vinyl wash[MPI #80].
 - b. Intermediate Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[MPI #72].
- E. Wood Substrates:

1. Pigmented Polyurethane System:
 - a. Prime Coat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy-Modified Latex System:
 - a. Prime Coat: Epoxy-modified latex, interior, gloss [Gloss Level 6][MPI #115].
 - b. Intermediate Coat: Epoxy-modified latex, interior, gloss [Gloss Level 6][MPI #115].
 - c. Topcoat: Epoxy-modified latex, interior, gloss [Gloss Level 6][MPI #115].

B. Steel Substrates:

1. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].
2. Pigmented Polyurethane over Epoxy Zinc-Rich Primer System:
 - a. Prime Coat: Primer, zinc-rich, epoxy[MPI #20].
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].

C. Galvanized-Metal Substrates:

1. Pigmented Polyurethane System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].

D. Aluminum [Not Anodized or Otherwise Coated] Substrates:

1. Pigmented Polyurethane System:
 - a. Prime Coat: As recommended in writing by topcoat manufacture.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacture.
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss [Gloss Level 6][MPI #72].

END OF SECTION 099600

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SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Markerboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Include sections of typical trim members.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: ASTM A 424, enameling-grade steel, uncoated thickness indicated; with exposed face and edges coated with primer, 1.7-to-2.5-mil- (0.043-to-0.064-mm-) thick ground coat, and color cover coat; and with concealed face coated with primer and 1.7-to-2.5-mil- (0.043-to-0.064-mm-) thick ground coat.

1. Products: Subject to compliance with requirements, provide the following, or Clardige approved equal.
 - a. PolyVision Corporation, a Steelcase company, P³ ceramicsteel Markerboard: E3 110 Series with marker tray and cork map rail.
- B. Extruded Aluminum: ASTM B 221 [ASTM B 221M], Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- [0.53-mm-] thick, porcelain-enamel face sheet with high gloss finish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Claridge Products and Equipment, Inc.
 - b. PolyVision Corporation; a Steelcase company.

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- [1.57-mm-] thick, extruded aluminum; standard size and shape .
 1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous.
- C. Map Rail: Provide the following accessories:
 1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 inch [25 mm] wide.
 2. End Stops: Located at each end of map rail.

2.4 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
- C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.6 VISUAL DISPLAY SURFACE SCHEDULE

- A. Visual Display Board: Factory assembled.

1. Markerboard: **Porcelain-enamel** markerboard assembly.
 - a. Color: **White**
2. Corners: **Square**
3. Width: **As indicated on Drawings.**
4. Height: **As indicated on Drawings.**
5. Mounting: **Wall**
6. Mounting Height: **As indicated on Drawings.**
7. Factory Applied Aluminum Trim: **Manufacturer's standard with clear anodic finish.**
8. Accessories:
 - a. Marker tray .
 - b. Map rail with display rail and end stops.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
- B. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- C. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.
- D. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room. Cover and protect visual display surfaces.

END OF SECTION 10100

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SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Panel signs.
2. Jobsite Sign.

1.2 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
1. Panel Signs: Not less than 6 inches (305 mm) square.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.
- B. Coordinate placement of jobsite sign with Owner and Architect.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. A. R. K. Ramos
 - 2. ASI-Modulex, Inc.
 - 3. Gemini Incorporated.
 - 4. Mohawk Sign Systems.
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
 - 1. Material: Plastic.
 - 2. Shape:
 - a. Restroom Doors: Provide 8" diameter panel with graphic symbol and tactile letters
 - b. Exit Doors: Provide 2" x 6" vertical panel with "EXIT" letters composed vertically and tactile letters
 - 3. Color: Selected from manufacturer's full color range.
 - 4. Edge Condition: Square.
 - 5. Corner Condition: Square (where applicable).
 - 6. Mounting: Unframed.
 - a. Wall mounted with silicone adhesive.
 - b. Manufacturer's standard anchors for substrates encountered.
 - 7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.

2.2 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 2. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.3 FINISHES, GENERAL

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 JOBSITE SIGN

- A. Project Identification and Temporary Signs.
 - 1. Provide Project identification and other signs, including, but not limited to 4'-0" x 8'-0" project sign per the attached sketch. Coordinate information to be included on project sign with Architect and Owner prior to fabrication. Unauthorized signs are not permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

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SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plaques.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plaques.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each plaque at least **full size**.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Plaque Schedule: Use same designations specified or indicated on Drawings or in a plaque or sign schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLAQUES

- A. Etched Plaque: Chemically etched or photochemically engraved metal sheet or plate with texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. A.R.K. Ramos.
 - b. APCO Graphics, Inc.
 - c. Gemini Incorporated.
 - d. Metal Arts.
- 2. Plaque Material: Sheet or plate **aluminum**.
 - 3. Plaque Thickness: **0.250 inch (6.35 mm)**.
 - 4. Plaque Size: **29 inches wide by 24 1/4 inches tall**.
 - 5. Finishes:
 - a. Integral Aluminum Finish: **Clear anodized**.
 - b. Overcoat: **Manufacturer's standard baked-on clear coating**.
 - 6. Integral Edge Style: **Square cut, polished**.
 - 7. Mounting: **Concealed studs**.
 - 8. Plaque graphic to be provided by Architect.

2.2 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - 3. Plaque Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

2.4 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.
 - 1. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 3. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
 - 4. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

- C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

- 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match plaque-background color unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plaque work.
- B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
 - 2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast dimensional characters.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least **3" = 1'-0"**.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **Five years from date of Substantial Completion.**

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

- A. Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
Basis-of-Design Product: Subject to compliance with requirements, provide **A.R.K. Ramos Signage Systems** or approved equal
- B. Letter Type 1 – Exterior Sign Wall

1. Character Material: Cast aluminum
 2. Character Height: 11-3/4" Tall
 3. Thickness: 1"
 4. Typeface: Arial
 5. Finish: Clear Anodized
 6. Mounting: Concealed fastener, projecting studs. Spacer mount studs with 1/2" standoff.
- C. Letter Type 2 - Interior Reception Wall
1. Character Material: Cast aluminum
 2. Character Height: As indicated on drawings (3 1/4", 3")
 3. Thickness: 3/4"
 4. Typeface: Helvetica
 5. Finish: Clear Anodized
 6. Mounting: Concealed studs.

2.2 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish **nonferrous-metal** or stainless steel devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use **flathead or oval countersunk** screws and bolts with tamper-resistant **head** slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Internally brace signs for stability and for securing fasteners.

5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish **to match sign-background color** unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and through substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten. Follow exterior material manufacturers requirements for penetrations and signage mounting.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 102113- PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic-core toilet compartments configured as **toilet enclosures and urinal screens.**
- B. Related Requirements:
 - 1. **Section 061000 "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.**
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of centerlines of toilet fixtures.
 - 3. Show locations of floor drains.
 - 4. Show **ceiling grid, ceiling-mounted items, and overhead support or bracing locations.**
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
- E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hinges: **One** hinge(s) with associated fasteners.
 - 2. Latch and Keeper: **One** latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: **One** door bumper(s) with associated fasteners.
 - 4. Door Pull: **One** door pull(s) with associated fasteners.
 - 5. Fasteners: **Ten** fasteners of each size and type.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: **25** or less.
 - 2. Smoke-Developed Index: **450** or less.
- B. Regulatory Requirements: Comply with applicable provisions in (the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities) (and) (ICC A117.1) for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Basis-of-Design Product: **Accurate Partitions Corp.; ASI Group.** Alternative products considered only through approval by Architect.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid through-color phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.
- E. Pilaster **Shoes and Sleeves (Caps)**: Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- F. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, **stainless steel.**
 - 2. Full-Height (Continuous) Type: Manufacturer's standard design; **stainless steel.**
- G. Phenolic-Panel Finish:
 - 1. Facing Sheet Finish: **One color and pattern** in each room.

2. Color and Pattern: color equal to Accurate Partitions Graphite Grafix #3020 with manufacturer's standard through-color core matching face sheet.
3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
 1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees allowing emergency access by lifting door. Mount with through-bolts.
 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in clear anodized finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

- E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- F. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: **1/2 inch.**
 - b. Panels and Walls: **1 inch.**
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than **two brackets attached** near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

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SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated, acoustical panel partitions.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]**.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable panel partitions.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Delegated-Design Submittal: For operable panel partitions.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Setting Drawings: For embedded items and cutouts required in other work **[including support-beam, mounting-hole template]**.
- C. Product test reports.
- D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **[Two]** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
 2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
- B. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency.
 - a. Flame-Spread Index: **25** or less.
 - b. Smoke-Developed Index: **450** or less.
 2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to **NFPA 265 Method B Protocol or NFPA 286**.

2.2 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Hufcor 632 for center stacking application as indicated on Drawings**, or comparable product by one of the following:
 - a. Advanced Equipment Corporation.
 - b. FolDoor; Holcomb & Hoke Mfg. Co., Inc.
 - c. KWIK-WALL Company.
 - d. Moderco Inc.
 - e. Modernfold, Inc.; a DORMA Group company.
 - f. Panelfold Inc.
- B. Panel Operation: **Manually operated, paired panels**.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

- E. STC: Not less than **45**.
- F. Panel Materials:
 - 1. Steel Frame: Steel sheet, manufacturer's standard thickness.
 - 2. Steel Face/Liner Sheets: Tension-levleed steel sheet, manufacturer's standard thickness.
 - 3. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; manufacturer's standard strengths and thicknesses for type of use.
 - 4. Gypsum Board: ASTM C 1396/C 1396M.
 - 5. Cement Board: ASTM C 1288.
 - 6. Particleboard: ANSI A208.1, **made with binder containing no urea formaldehyde.**
 - 7. Medium-Density Fiberboard: ANSI A208.2, **made with binder containing no urea formaldehyde.**
 - 8. Plywood: DCC PS 1; **made with adhesive containing no urea formaldehyde.**
- G. Panel Closure: Manufacturer's standard.
- H. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.3 SEALS

- A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
 - 1. Seals made from materials and in profiles that minimize sound leakage.
 - 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels end between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
 - 1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than [1-1/2 inches (38 mm)] between retracted seal and floor finish.

2.4 PANEL FINISH FACINGS

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Pattern/Color: **"Delight" Steel 48-10.**
- B. **"Revelations" High-performance Woven Fabric Material:** Manufacturer's high performance woven fabric; VOC, ODS, PVC, Heavy metal and formaldehyde free.
- C. Paint: Manufacturer's standard factory-painted finish.
- D. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.

2.5 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum [directly attached to glulam beam] designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch [2.54 mm] between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- E. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.2 ADJUSTING

- A. Adjust to operate smoothly and easily, without binding or warping.
- B. Verify that safety devices are properly functioning.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 10223

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Childcare accessories.
 - 3. Underlavatory guards.
 - 4. Owner Furnished materials, see enlarged restroom floor plan sheet.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full size, for each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser, see A1.3:
 - 1. Description: **Single-roll dispenser.**
 - 2. Mounting: **Surface mounted.**
 - 3. Operation: **Noncontrol delivery with theft-resistant spindle.**
 - 4. Capacity: Designed for **4-1/2- or 5-inch** diameter tissue rolls.
 - 5. Material and Finish: **Stainless steel, No. 4 finish (satin).**

B. Paper Towel (Folded) Dispenser, see A1.3

1. Mounting: **Surface mounted.**
2. Minimum Capacity: **600 C-fold or 800 multifold towels.**
3. Material and Finish: **Stainless steel, No. 4 finish (satin)**
4. Lockset: **Tumbler type.**
5. Refill Indicator: **Pierced slots at sides or front.**

C. Grab Bar, see A1.13:

1. Basis-of-Design Product: **Bobrick ASI 163 (36" long) and ASI 166 (42" long).**
2. Mounting: **Flanges with concealed fasteners.**
3. Material: **Stainless steel, 0.05 inch thick.**
 - a. Finish: **Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.**
4. Outside Diameter: **1-1/2 inches.**
5. Configuration and Length: **As indicated on Drawings.**

D. Sanitary-Napkin Disposal Unit, see A1.3:

1. Mounting: **Surface mounted.**
2. Door or Cover: **Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.**
3. Receptacle: **Removable.**
4. Material and Finish: **Stainless steel, No. 4 finish (satin).**

E. Coat Hook, see A1.3:

1. Description: **Double prong unit.**
2. Material and Finish: **Stainless steel, No. 4 finish (satin).**

F. Lavatory-mounted Soap Dispenser, see A1.3:

1. Basis of Design: **B-8221**
2. Material and Finish: **Chrome**

2.3 CHILDCARE ACCESSORIES

A. Diaper-Changing Station, see A1.3:

1. Basis-of-Design: **Koala Bear Care Model KB110-SSRE Stainless Steel**
2. Description: **Horizontal unit that opens by folding down from stored position and with child-protection strap.**
 - a. Engineered to support minimum of **250-lb** static load when opened.
3. Mounting: **Recessed**
4. Operation: **Gas spring mechanism.**
5. Material and Finish: **Stainless steel exterior and polyethylene interior.**
6. Liner Dispenser: **Built in.**

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard, see A1.3 and A6 sheets:

1. **Plumberex Specialty Products, Inc.**
Truebro by IPS Corporation.
2. Description: **Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.**
3. Material and Finish: **Antimicrobial, molded plastic, white.**

2.5 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.
- B. Related Requirements:
 - 1. Section 104416 "Fire Extinguishers."
 - 2. Section 211200 "Fire-Suppression Standpipes" for fire-hose connections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of [fire extinguishers] indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire [extinguisher]

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Specialties, Inc.
 - b. Guardian Fire Equipment, Inc.
 - c. JL Industries, Inc.: a division of the Activar Construction Products Group.
 - d. Larsens Manufacturing Company.
 - e. Modern Metal Products, Division of Technico Inc.
 - f. MOON American.
 - g. Nystrom, Inc.
 - h. Potter Roemer LLC.

- B. Cabinet Construction: [1-hour fire rated].

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- [1.09-mm-] thick cold-rolled steel sheet lined with minimum 5/8-inch- [16-mm-] thick fire-barrier material. Provide factory-drilled mounting holes.

- C. Cabinet Material: [Cold-rolled steel sheet].

1. Shelf: Same metal and finish as cabinet.

- D. Recessed or Semirecessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch [32- to 38-mm] backbend depth.

- E. Cabinet Trim Material: Stainless Steel.

- F. Door Material: [Steel sheet]. White baked enamel.

- G. Door Style: [Flush opaque panel, frameless, with no exposed hinges].

- H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide **projecting door pull and friction latch**.
2. Provide **concealed hinge** permitting door to open 180 degrees.

- I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [as directed by Architect].
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER".
 - 1) Location: Applied to **cabinet door**.
 - 2) Application Process: **Pressure-sensitive vinyl letters**.
 - 3) Lettering Color: **Black**.
 - 4) Orientation: **Horizontal**.

J. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: **Baked enamel or powder coat**.
 - b. Color: **White**.
2. Stainless Steel: ASTM A 666, Type 304.
 - a. Finish: **No. 4 directional satin finish**.

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch [13 mm] thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where [semirecessed] cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for **recessed or semirecessed** fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated[or, if not indicated, at heights indicated below:]
 - 1. Fire-Protection Cabinets: **[54 inches [1372 mm]]** above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Apply **vinyl lettering** at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, [hand-carried] fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: [Six] years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each [fire-protection cabinet] [and] [mounting bracket] indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International.
 - c. Badger Fire Protection.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - h. Kidde Residential and Commercial Division.
 - i. Larsens Manufacturing Company.
 - j. MOON American.
 - k. Nystrom, Inc.
 - l. Pem All Fire Extinguisher Corp.; Pem Systems, Inc.
 - m. Potter Roemer LLC.
 - n. Pyro-Chem; Tyco Fire Suppression & Building Products.
 - o. Strike First Corporation of America.
 - 2. Valves: **[Manufacturer's standard]**.
 - 3. Handles and Levers: **[Manufacturer's standard]**.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B
- B. Multipurpose Dry-Chemical Type in Aluminum Container <Insert drawing designation>: UL-rated [2-A:10-B:C, 5-lb (2.3-kg)] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container. Insert other types and capacities to suit Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416

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SECTION 111313 - LOADING DOCK BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes loading dock bumpers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of loading dock bumper.
- B. Shop Drawings: For dock bumpers. Include plans, elevations, sections, details, and attachments to other work.

PART 2 - PRODUCTS

2.1 DOCK BUMPERS

- A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.
- B. Molded-Rubber Dock Bumpers **per 1/A3.3**. Fabricated from molded-rubber compound reinforced with nylon, rayon, or polyester cord; with Type A Shore durometer hardness of 80, plus or minus 5, when tested according to ASTM D 2240; of size and configuration indicated. Fabricate units with not less than two predrilled anchor holes.
 - 1. Configuration: **Rectangular [vertical]**.
 - 2. Thickness: **6 inches**
- C. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
- D. Materials: ASTM 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanize according to ASTM A 123/A 123M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Dock Bumpers: Attach dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
 - 1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.
 - 2. Screw Attachment: Attach dock bumpers to wood construction with lag bolts as indicated.

3.3 ADJUSTING

- A. After completing installation of exposed, factory-finished dock bumpers, inspect exposed finishes and repair damaged finishes.

END OF SECTION 111313

SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electrically operated, front-projection screens and controls.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
 - 1. Location of seams in viewing surfaces.
 - 2. Anchorage details, including connection to supporting structure for suspended units.
 - 3. Location of wiring connections for electrically operated units.
 - 4. Wiring diagrams for electrically operated units.
- C. Warranty: Entire screen assembly including the electric motors shall be warranted for **no less than 1-year**.

PART 2 - PRODUCTS

2.1 ELECTRICALLY OPERATED, FRONT-PROJECTION SCREENS

- A. General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation.
 - 1. Controls: Remote three-position control switch.
 - a. Provide locking cover plates for switches.
 - b. Provide key-operated, power-supply switch.
 - c. Provide remote control consisting of battery-powered transmitter and receiver.
 - d. Provide video interface control for connecting to projector. Projector provides signal to raise or lower screen.
 - 2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, and positive-stop action to prevent coasting.
 - 3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch diameter metal rod with ends of rod protected by plastic caps.
 - 4. Tab Tensioning: Provide units that have a durable low-stretch cord, such as braided polyester, on each side of screen that is connected to edge of screen by tabs to pull screen flat horizontally.
- B. Suspended, Electrically Operated Screens without Ceiling Closure and with Tab Tensioning: Motor-in-roller units designed and fabricated for wall mounting, with bottom of case entirely or partially open under screen compartment.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Da-Lite Screen Company, #21799LC "Tensioned Contour"
- 2. Provide screen case with trim flange to receive ceiling finish.

2.2 FRONT-PROJECTION SCREEN MATERIAL

- A. Matte-White Viewing Surface: Peak gain of not less than 0.9, and gain of not less than 0.8 at an angle of 60 degrees from the axis of the screen surface.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Da-Lite Screen Company, "HD Progressive 0.9"
- B. Material: Vinyl-coated, glass-fiber fabric.
- C. Seamless Construction: Provide screens, in sizes indicated, without seams.
- D. Edge Treatment: Black masking borders (2" visible black drop at top).
- E. Size of Viewing Surface: HDTV 16:9 format, 159 inch nominal diagonal dimension.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install front-projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
 - 1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 - 2. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.

END OF SECTION 115213

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Motor-operated roller shades with single rollers.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than **10 inches** square. Mark interior face of material if applicable.

E. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the drawings and include opening sizes and key to typical mounting details.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to

avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.
- B. Subject to compliance with requirements, provide products from one of the following manufacturers:
 - 1. Basis of Design: **Springs Window Fashions (SWF Contract) with Standard Wired Motors by Somfy**
 - 2. MechoShade Systems, Inc.
 - 3. Draper
 - 4. Hunter Douglas

2.2 MOTOR-OPERATED, SINGLE-ROLLER SHADES

- A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions as indicated on drawings, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 - 1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Electric Motor: **Standard Wired Motor:** Tubular asynchronous motor, built-in reversible capacitor, brushless 110 V AC (60 Hz) single phase motor; thermally protected, permanently lubricated gear-box, maintenance free, minimum 6 NM torque lifting capacity. Motors must have rapid adjustment capabilities.
 - a. To be fitted inside aluminum roller tube with appropriate adaptors for smooth operation. Tubular, asynchronous operator, built in reversible capacitor, brushless, 120 V AC, 60 Hz, single phase motor, thermally protected, permanently lubricated gear-box, maintenance free.
 - b. Equipped with 18 inch motor lead with quick disconnect of power cord.
 - c. Maximum Shade Drop: As required to operate roller shades indicated.
 - d. Maximum Weight Capacity: As required to operate roller shades indicated.
 - 3. Multi-motor group controllers:
 - a. GCS-II, Master group controller: Master/Group operation only, fuse protected, low voltage switching, and capable of interfacing with third party systems using dry contacts, operated using a décor style switch
 - b. Single switch (each room) to operate all shades simultaneously. **Coordinate location with Architect.**
 - c. Color: **White**
 - 4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights end widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: Right side of interior face of shade.
 - 2. Direction of Shadeband Roll: (Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join all inline rollers that are

operated by one roller drive-end assembly.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.

F. Installation Accessories:

1. Endcap Covers: To cover exposed endcaps.
2. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than **height indicated on Drawings**.
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: **As indicated on Drawings**.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
1. Source: **Roller shade manufacturer.**
 2. Type: **Fiberglass and Vinyl**
 3. Weave: **Basketweave.**
 4. Thickness: **0.016 inches.**
 5. Weight: **10.7 oz./sq. yd.**
 6. Roll Width: **48", with odd sizes to be coordinated with Architect**
 7. Orientation on Shadeband: **Up the bolt.**
 8. Openness Factor: **5 percent.**
 9. Color: **E Screen 7505: 02.07 "White Pearl"**

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Outside of Jamb Installation: Width and length as indicated, with **terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.**
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than **1:4**, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, **locations of connections to building electrical system**, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
- C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123661 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants."

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials and sinks.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONOITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements **after base cabinets are installed but before countertop fabrication is complete.**

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRDDUCTS

2.1 SDLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
 - 1. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - 2. Basis-of-Design: **Formica Classics 757 "Luna Sand" 1/2" thick.**

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: **Premium.**
- B. Configuration:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: **1/2-inch** thick, solid surface material with front edge built up with same material.
- D. Backsplashes: **1/2-inch** thick, solid surface material.
- E. Fabricate tops with shop-applied edges **and backsplashes** unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops without joints.
- G. Cutouts and Holes:
 - 1. Plumbing Fixtures: Make cutouts for fixtures **in shop** using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.

- c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
- 2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent

damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

- I. Apply sealant to gaps at walls.

END OF SECTION 123661

SECTION 220100 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections shall apply to this Section.

1.2 SPECIFICATION FORM AND DEFINITIONS:

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as noted on the Drawings", "according to the drawings", "a", "an", "the", and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- B. Refer to Section 007000, General Conditions, Article 1 for definitions that apply to these specifications.

1.3 GENERAL EXTENT OF WORK:

- A. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which the Contractor could have informed himself before bids were taken.
- B. The Contractor shall familiarize himself with equipment provided by other Contractors, which require mechanical connections and controls.

1.4 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

1.5 CODES, ORDINANCES, RULES AND REGULATIONS

- A. Provide work in accordance with applicable codes, rules, ordinances, and regulations of Local, State and Federal Governments and other authorities having lawful jurisdiction.
- B. Conform to latest editions and supplements of following codes, standards or recommended practices as adopted by the authority having jurisdiction.
 - 1. CITY CODES:
 - a. 2015 International Building Code.
 - b. 2015 International Plumbing Code.
 - c. 2015 International Fuel Gas Code.
 - d. 2015 International Mechanical Code.
 - e. 2015 International Fire Protection Code.

2. SAFETY CODES:

- a. National Electric Safety Code Handbook H30- National Bureau of Standards.
- b. Occupational Safety and Health Standards - Department of Labor.
- c. Specifications for Making Buildings and Facilities Accessible To, and Usable By, the Physically Handicapped - American National Standards Institute ANSI A117.1

3. NATIONAL FIRE CODES:

- a. NFPA No. 54 Gas Appliance and Gas Piping Code.
- b. NFPA No. 70 National Electric Code - 2002 Edition.
- c. NFPA No. 89M Clearances, Heat Producing Appliances.
- d. NFPA No. 9DA Air Conditioning and Ventilation Systems.
- e. NFPA No. 91 Blower and Exhaust Systems.
- f. NFPA No. 101 Life Safety Code - Current Edition.

- C. Where following standards are applicable to equipment specified, equipment shall conform to requirements of standard and shall display the appropriate seal or seals:

- 1. AGA - The American Gas Association Laboratories.
- 2. ASME - American Society of Mechanical Engineers.
- 3. NSF National Sanitation Foundation.
- 4. UL Underwriters Laboratories Inc.

- D. Drawings and specifications indicate minimum construction standards, but should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, the Contractor shall execute work in accordance with such ordinances, laws, codes rules or regulations without increased cost to Owner, but not until he has referred such variances to Project Manager for approval.

- E. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submits two copies to Project Manager with request for final inspection.

1.6 CONTRACT CHANGE

- A. Changes or deviations from contract; including those for extra or additional work must be submitted in writing for review of Project Manager. No verbal orders will be recognized.
- B. Reference Section 007D00, General Conditions, Article 26 regarding changes in the work.
- C. All change proposals shall be itemized indicating separately the costs for materials, labor, restocking changes, freight, bonds, insurance, overhead and profit. All materials shall be listed separately with quantities and individual unit prices. Labor factors shall be from a nationally recognized source with appropriate adjustment factors.

1.7 LOCATIONS AND INTERFERENCES

- A. Locations of equipment, piping and other mechanical work is indicated diagrammatically by mechanical drawings. Determine exact locations on job, subject to structural conditions, work of other Contractors, access requirements for installation and maintenance and to approval of Project Manager.
- B. Study and become familiar with contract drawings of other trades and in particular the general construction plans and details to obtain necessary information for figuring installation. Cooperate with other workmen and install work to avoid interference with their work. Minor deviations, not affecting

design characteristics, performance or space limitations may be permitted if reviewed by Project Manager prior to installation.

- C. Any pipe, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, his subcontractor, or his workmen shall be restored as specified for new work.
- D. Do not scale mechanical and electrical drawings for dimensions. Accurately lay out work from dimensions indicated on architectural drawings unless such be found in error.

1.8 SYSTEM PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended, work shall include required adjustment of systems and control equipment installed under this specification.

1.9 WARRANTY

- A. Refer to 070000, General Conditions, Article 32 for additional warranty requirements.
- B. The Contractor warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after date of substantial completion of building and acceptance of mechanical systems by Owner.
- C. Where manufacturers' warranties expire during the one year warranty period, the Contractor shall include provisions for extending warranty for the full one year period and shall include cost for warranty extension in his base bid. Where warranty extensions are not available from manufacturer, supplier or installer, the Contractor shall provide labor, parts and material warranty services equal to the requirements of these specifications and the terms of the manufacturer, supplier and installer warranties.
- D. The Contractor warrants to Owner and Architect that on receipt of written notice from either of them within one year warranty period following date of acceptance all defects that have appeared in materials and /or workmanship, shall be promptly corrected to condition required by contract documents at the Contractor's expense.
- E. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

1.10 MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. Reference Section 007000, General Conditions, Article 16 - SUBSTITUTIONS AND "OR APPROVED EQUAL"
- B. The intent of these specifications is to allow ample opportunity for the Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- C. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- D. In general these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturers product, series, model, catalog and/or identification numbers shall set quality and

capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer's names are listed they are considered an approved manufacturer for the product specified, however, the listing of their names implies no prior approval of any product they may propose to furnish as equivalent to the first named product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for the Contractor's base bid proposal it shall be his responsibility to determine prior to bid time that his proposed materials and equipment selections are products of approved manufacturers, that will meet or exceed the specifications and are acceptable to the Design Engineer.

- E. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Project Manager for review prior to procurement.
- F. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Project Manager whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. See substitution requirements in Article 16 of the General Conditions 007000 - Requests must be accompanied by two copies of complete descriptive and technical data including Manufacturer's name, model, and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

1.11 SHOP DRAWINGS, OPERATION AND MAINTENANCE INSTRUCTION

- A. Reference Section 007000, General Conditions, Article 18 - Shop Drawings & Section 013300, Submittal Procedures
- B. The Contractor shall furnish digital shop drawings of all materials and equipment for review by Project Manager.
- C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fittings, sizes, etc. that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, OR PLAN SHEET NUMBER when item does not appear in specifications. Where equipment submitted does not appear in base specifications of specified equivalent, mark submittals with applicable alternate numbers, change order numbers, change order number or letters of authorization. Each submittal shall contain at least two sets of original catalog cuts. Each catalog sheet shall bear Manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.
- D. Project Manager will not be responsible for the cost of returning shop drawing submittals that are submitted to them without the Contractor's review and approval stamp. A letter will be sent to the Contractor by either the Architect or Engineer indicating receipt of an improper submittal. The Contractor shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. Project Manager will hold improper submittals for pick-up by the Contractor or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals will be disposed of by Project Manager.
- E. Project Manager's review of shop drawings will not relieve the Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner of his representative, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until Project Manager's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be the Contractor's responsibility.

F. Operating and Maintenance Instructions:

1. Reference Section 007000, General Conditions, Article 32 & Section 013000, Submittal Procedures.
2. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical systems.

1.12 RECORD DOCUMENTS

- A. Reference Section 007000, General Conditions, Article 31.
- B. Record Drawings: Maintain a reproducible set of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding location on working drawings. Mark with red erasable red pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Markup new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work, which would be difficult to measure and record at a later date. Note related change-order numbers where applicable. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and prints suitable titles, dates and other identification on cover of each sheet.
- C. Record Specifications: Maintain one copy of specifications, including addenda, change orders, and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of option, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable. Upon completion of mark-up submit to Architect/Engineer for Owner's records.
- D. The Contractor shall provide a full set of photographs showing all underground equipment. The photographs shall be taken prior to any concrete being poured. The underground equipment shall consist of, but not be limited to, piping, conduits, ductwork.
- E. The Contractor shall provide the photographs in an 8.5" x 11" format for record keeping purposes with the maintenance manuals. The photos shall all be digital and a disk or C.D. shall be provided to the Owner as a permanent record.

1.13 ELECTRICAL REQUIREMENTS

- A. Consult Section 026000 of electrical specifications for work to be provided by the Contractor in conjunction with installation of mechanical equipment.
- B. Electrical work required to install and control mechanical equipment which is not shown on plans or specified under Section 026000 shall be included in the Contractor's base bid proposal.
- C. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in the specifications shall be paid by the Contractor at no cost to Owner or Project Manager.
- D. The Contractor shall be responsible for providing supervision to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

- E. The Contractor shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approval form which shall be presented monthly, or on request. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow the Contractor to order electrical equipment required in his contract.
- F. Safety disconnect switches and manual and magnetic motor starters shall be provided by the Contractor. Exceptions will be allowed where mechanical equipment is provided with these devices installed as part of factory built control systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

PART 4 - EXHIBITS (NOT USED)

END OF SECTION 220100

SECTION 220500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and section 220100 - General Mechanical Requirements shall apply to this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

- A. The Contractor shall do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Architect's approval and in a manner approved by him.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Architect.
- C. Drilling and cutting of openings through building materials requires Architect's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Do not use star drill or air hammer for this work.

3.2 PIPE SLEEVES

- A. Provide proper type and size pipe sleeves and install in walls or floors and where otherwise noted. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab on grade except where penetrating a membrane waterproof floor.
- B. Each sleeve shall be continuous through wall, floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved. Sleeves shall be required through floors subject to flooding such as toilet rooms, equipment rooms and kitchens. The contractor shall have the option of:
 - 1. Providing a cast iron sleeve with integral flanges extending 1 inch above finished floor. Sleeve shall be cast in concrete when floor is poured. Annular space between sleeve and pipe shall be filled with Kaowool.
 - or
 - 2. Provide core-drilled opening in concrete with Thunderline Link-Seal or Calpico Sealing Linx between piping and opening.
- C. Sleeves passing through floors with waterproof membranes shall be core-drilled and sealed with Thunderline Link-Seal or Calpico Sealing Linx.
- D. Sleeves passing through walls with waterproof membranes shall be sealed with Thunderline Link-Seal or Calpico Sealing Linx.

- E. Pipe insulation shall run continuous thru pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing thru fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Provide Kaowool fire master bulk packing between sleeve and metal jacket. Packing thickness shall be sized per manufacturers recommendation for maintaining the integrity, of the fire wall/floor or smoke partition. Fire protection system shall be rated per ASTM E 119. Equivalents to Kaowool are 3M, Flame Stop or Flame Safe.
- F. Where piping passes through walls serving as air plenums or chases, seal annular space between pipe and sleeve air tight with Kaowool Firemaster Bulk Packing.

3.3 OPENINGS

- A. This Contractor shall include the installation of all boxes and sleeves for openings required to install this work, excepting only structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown.
- B. Penetrations in walls for sheet metal ducts shall be sealed by the the Contractor by stuffing glass fiber into the cracks between the walls, and floors and the ducts. The exposed joints shall then be caulked on each side with non-hardening caulking such as "Tremco Acoustical Sealant". This work applies to all walls in buildings.

3.4 MUTILATION

- A. Mutilation of building finishes, caused by installation of mechanical equipment, fixtures, piping and other mechanical devices shall be repaired at the Contractor's expense to approval of Owner.

3.5 EXCAVATION AND BACKFILL

- A. Perform necessary excavating to receive work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. as required and remove same at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
- C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footings with selected concrete fill and tamp to compaction required by the Project Manager. Mechanically tamp backfill under concrete and pavings in 6 inch layers to 95% standard density.
- D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by the Project Manager.
- E. When available, refer to test hole information on Architectural drawings or specifications for types of soil to be encountered in excavation in base bid.

3.6 WELDING

- A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standards B31.1.
- B. Welding shall be done only by welders who have successfully passed welder qualification tests in previous 12 months for type of welding required. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders code, date and types of latest qualifications test passed by each welder.
- C. Welded joints shall be fusion-welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
- D. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

3.7 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment.
- B. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown, specified or required by the Manufacturer's installation instructions.
- C. Provide concrete bases for all floor and slab mounted equipment. Refer to drawings for required base type and size. Provide 3 1/2" high base where base is not shown on drawings.

3.8 PAINTING OF MATERIALS AND EQUIPMENT

- A. Equipment and materials exposed to interior dry environment shall have a minimum of one primer and one finish coat. Equipment and materials mounted in exterior location shall have a minimum of one primer and two finish coats with total thickness of at least 5 mils. Finish coat colors in finish areas shall be as selected by Project Manager.
- B. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- C. Where extensive refinishing of factory applied finishes are required equipment shall be completely repainted. Project Manager will make final determination on extent of refinishing required.
- D. Paint all exterior natural gas piping with one primer coat and two finish coats.

3.9 MAINTENANCE OF SYSTEMS

- A. The Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under the contract.

3.10 FILTERS

- A. Provide temporary MERV 8 throw-away filters in all permanent heating and air conditioning equipment systems and the return ductwork being utilized during construction. Prior to testing and balancing systems remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment for final acceptance inspection by Project Manager.
- B. Final filters shall have a MERV 13 rating equal to Farr AP thirteen.

3.11 ACCESS PANELS

- A. Milcor, Wade or Zurn access panels shall be provided wherever necessary to provide access to valves, traps, etc., located in concealed spaces. Each fire damper, automatic splitter damper, etc., shall have an access panel. Size shall be adequate for inspection and removal of equipment and none shall be less than 12" x 6".
- B. Duct Access Doors: Doors shall be equivalent to CESCO Model 14AD-5. Frame shall not be less than 22 gauge galvanized steel, with 24 gauge door panels. Doors shall have minimum 1" thick insulation, PVC foam tape gaskets, zinc plated steel continuous type hinge and latches. Equivalent by Nailor.
- C. Mechanical Wall Access Doors: Doors shall be equivalent to CESCO Model FW-SS, all purpose access panel. Frame shall be 16 gauge stainless steel #304, with 14 gauge stainless steel #304 frame. The hinge shall be continuous stainless steel - concealed. The latch shall be flush mounted screwdriver operated cam latch. The finish shall be #304 stainless steel with a #4 satin finish.
- D. Fire Rated Wall/Ceiling Access Door: Doors shall be equivalent to CESCO model FB. Frame shall be 16 gauge galvanized bonderized steel and 20 gauge galvanized bonderized steel. Hinges shall be continuous, galvanized steel with stainless steel pin and a key-operated latch. Provide automatic type door closure. Door shall have a UL rating to match rating of wall/ceiling rating.

3.12 CLEANING AND FLUSHING HEATING HOT WATER SYSTEMS

- A. The heating hot water system for project shall be thoroughly cleaned before placing in operation to rid system of dirt, piping compound, mill scale, oil and any other foreign material.
- B. After system is complete, the Contractor shall fill piping loop and all runouts with clear water. For this purpose supply and return runouts shall be temporarily connected together at each air handling and fan coil unit location. There shall be no water flow through air handling and fan coil unit. Loop water shall be circulated for one hour with make up water open and drain open to accomplish initial flushing of system.
- C. After initial flushing, individual air handling and fan coil, etc. units shall be connected permanently to supply and return runouts and system filled for operation under normal closed loop conditions. Contractor shall add trisodium phosphate in an aqueous solution to system at rate of one pound per fifty gallons of water in system. After system is filled with this solution, system water shall be brought up to 95 degrees F temperature and allowed to circulate for two hours. System shall then be drained completely and refilled with fresh water.
- D. After system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable method and shall be left slightly alkaline side (pH 7.5). If system is found to be still on the acid side, cleaning by use of trisodium phosphate shall be repeated.
- E. System Additives - the Contractor shall not add any "stop-leak" compounds to the system.

- F. Provide same cleaning and flushing as outlined above for the heating hot water system.

3.13 CLEANING OF SYSTEM AND EQUIPMENT

- A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment.
- B. Clean equipment as recommended by manufacturers. Where specific instructions are not provided by equipment manufacturer clean equipment systems as follows:
- C. Air Handling System: Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blowers, etc., with throwaway filters specified under this specification. After cleaning air system install temporary filters and run continuously for 8 hours at full volume.

3.14 STERILIZATION OF DOMESTIC WATER SYSTEM

- A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicate non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.
- B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization to sterilize valve parts.
- C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
- D. Test samples taken from several points in system shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

3.15 START-UP, CHANGE-OVER, TRAINING AND OPERATIONAL CHECK

- A. The Contractor shall perform initial start-up of systems and equipment and shall provide necessary supervision and labor to make first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including the Manufacturer's technicians when specified, and Owner's operating personnel shall be present during these operations.

3.16 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At the Contractor's request, Project Manager will make pre-final construction review to determine if to the best of their knowledge project is completed in accordance with plans and specifications. Items found by Project Manager as not complete or not in accordance with requirements of contract will be outlined in report to the Contractor. After completion and/or correction of these items the Contractor shall notify Project Manager that the Work is ready for final review.
- B. All necessary system adjustments including air and water systems balancing shall be completed and all specified records and reports submitted in sufficient time to be received by Project Manager at least ten working days prior to date of final construction review.

- C. At final construction review, the Contractor and his major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by Project Manager, that the Contractor's work complies with purpose and intent of plans and specifications. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

END OF SECTION 220500

SECTION 220600 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.
- B. Provide and be responsible for location of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturer's Standardization Society Specification (MSS) SP-58.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

- B. Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1 1/4"	3/8"	8 ft.
1 1/2" to 2"	3/8"	10 ft.
2 1/2" to 3 1/2"	1/2"	12 ft.
4" to 5"	5/8"	15 ft.
6"	3/4"	17 ft.
8" to 12"	7/8"	22 ft.

- C. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1"	3/8"	6 ft.
1 1/4" and 1 1/2"	3/8"	8 ft.
2"	3/8"	9 ft.
2 1/2"	1/2"	9 ft.
3" and 4"	1/2"	10 ft.

- D. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be used. Hanger rods shall be subjected to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support details to Architect-Engineer for review prior to fabrication.

- E. Provide Anvil pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	1/2" thru 4"	CT-121
Steel	3/4" thru 20"	261

- F. Provide Anvil Fig. 194, 195, 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.

- G. Provide Anvil Fig. 167 protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation. Omit copper plating on hangers mounted outside insulation on copper tubing.

- H. Structural Attachments for pipe hangers shall be as follows:

1. Concrete Structure: Provide Grinnell Fig. 285 concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge type concrete insert for loads up to 1200 lbs.
2. Steel Beam Structure: Provide Grinnell Fig. No. 86 malleable iron C-clamp for pipe size 2" and smaller and Grinnell Fig. 229 malleable iron beam clamp for pipe size 2-1/2" and larger.

PIPE MATERIAL	PIPE SIZE	HANGER FIG NO.
Copper	1/2" thru 4"	CT-65*
Steel	3/8" thru 4"	65
Steel	5" thru 30"	260

- I. Provide Anvil Fig. 45 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIAL	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	PS1100*	PS1901
Steel	3/8" thru 6"	PS1100	
PS1902			

*Copper Plated

- J. Provide necessary structural steel and attachment accessories for installation of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with A/E prior to installation.

2.2 EQUIPMENT ANCHORS

- A. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

2.3 CONCRETE INSERTS AND ANCHORS

- A. Provide concrete inserts for attaching piping and equipment as follows:
- B. In new construction where attachment points can be predetermined provide PHD Fig. 950 continuous concrete insert of Fig. 950N Universal Steel Concrete insert.
- C. In existing construction or new construction where attachment points can not be located before setting concrete forms provide McCulloch Kwik-Bolt or Phillips red head concrete anchors of proper type for attachments.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

- A. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments so that rod is vertical in hot position. Hangers shall not become disengaged by movements of supported pipe.
- B. Provide sufficient hangers to adequately support piping system at specified spacing at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustments to maintain pitch required for proper drainage and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.

- C. Hangers in direct contact with copper pipe or tubing shall be copper plated.
- D. Support horizontal cast iron soil pipe with one hanger for each joint located close to hub.
- E. Support plastic piping as recommended by piping manufacturer.
- F. Support vertical cast iron soil pipe and PVC pipe at every floor and steel and copper tubing at every other floor except where indicated otherwise on drawings.
- G. Mount hangers for insulated piping on outside of pipe, hangers sized to allow for full thickness of pipe insulation.

END OF SECTION 220600

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SECTION 220800 - PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Provide necessary materials and accessories for installation of insulation for plumbing and mechanical systems as specified and/or detailed on drawings insulation type, jacket, and thickness for specific piping systems or equipment shall be as listed in insulation schedule.
- B. Provide insulation materials manufactured by Certain Teed, Knauf, Dow Chemical, Johns Manville or Owen/Corning Fiberglas.
- C. Insulation, except where specified otherwise, shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255, and UL 723 procedures not exceeding:

FLAME SPREAD	25
SMOKE DEVELOPED	50
FUEL CONTRIBUTED	50

- D. Provided insulation accessories such as adhesives, mastics, cements, tape and glass fabric with same component ratings as listed above. Products or their shipping cartons shall bear label indicating their flame and smoke ratings. Treatment of jackets or facings for impart flame and smoke safety shall be permanent. Use of water soluble treatments such as corn paste or wheat paste is prohibited. This does not exclude approved lagging adhesives.
- E. Where glass is specified in the following insulation methods provide resin impregnated with open weave glass fabric with 10/20 thread count.
- F. Abbreviations for manufacturers of adhesives, mastics and coating specified shall be C.M. for Chicago Mastic Company and B.F. for Benjamin Foster Company.
- G. Pipe insulation materials and application methods by type shall be as follows:
 - 1. Elastomeric: Insulation for cold surface piping system with -40 degrees F to +220 degrees F operating temperature range shall be Armstrong AP Armaflex Elastomeric Pipe insulation average thermal conductivity shall not exceed 0.27 BTU/Hr. at 75 degrees F mean temperature. To greatest extent possible apply insulation without longitudinal joint by slipping insulation over piping. Seal all seams and butt joints with Armstrong 52D adhesive. Insulate fittings as follows:
 - a. Insulate fittings with Miter-Cut pieces of AP Armaflex pipe insulation equal to thickness of adjoining pipe insulation. Insulate fittings too large to cover with pipe insulation with insulation from fabricated Armaflex sheet insulation using Armstrong templates. Join and seal all fittings joints with Armstrong 52D adhesive. Finish insulation as soon as possible with two coats of Armstrong Armaflex vinyl- lacquer finish in color selected by Architect. All insulation used outdoors shall be painted to prevent ultra violet deterioration of insulation.
 - 2. Fiberglass: Insulation for hot and cold surface piping systems with -60 degrees F to +850 degrees F operating range shall be Owens-Corning Fiberglas 25 pipe insulation with white fire retardant ASJ jacket. Average 75 degrees F mean temperature. Seal longitudinal jacket laps

and butt strips with C.M. No. 17-465 or B.F. No. 85-75 vapor barrier adhesive. Insulate valves and fittings as follows:

- a. Insulate exposed and concealed valves and fittings with PVC premolded fitting covers. Provide "Zeston" Series 300 fitting covers as manufactured by Johns Manville.

H. Insulation materials and application methods for piping hangers supports, anchors, guides, expansion joints, etc., shall be as follows:

1. Insulate hangers and supports from direct contact with cold surfaces with Styrofoam HD- 300 plastic foam inserts of half or full sections of premolded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2" over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degrees of pipe insulation sized so that pipe compressive load does not exceed one third of insulation insert compressive strength. Seal joints with vapor barrier sealer specified for insulation type used.
2. Insulate pipe anchors in direct contact with cold piping for a distance of 12" or as detailed on drawings from contact point with piping. Anchor insulation shall be one half the thickness of adjoining pipe insulation with vapor barrier. Seal and finish joints with vapor barrier sealer specified for insulation type used.
3. Insulate pipe guides from direct contact with cold surfaces piping with Styrofoam HD-300 plastic foam full section inserts of premolded pipe insulation equal in thickness to adjoining pipe insulation. Provide inserts with vapor barrier jacket for overlapping 2" over adjoining pipe insulation. Insert jacket shall be equal in performance and appearance to adjacent insulation jacket. Seal and finish joints with vapor barrier sealer specified for insulation type used.
4. Insulate pipe expansion joints on cold surface piping with over-sized section of premolded pipe insulation equal in thickness to adjoining pipe insulation. Cover shall float free one end with expansion and contraction of piping system. Seal free end with 4 mil thick PVC vinyl sheet attached to adjoining insulation. Provide sufficient slack in vinyl material to allow for maximum pipe movement.
5. Where piping hanger can not be isolated from cold pipe surfaces insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to point 12" above pipe with minimum insulation thickness equal to one-half thickness of pipe insulation. Seal and finish joints with vapor barrier sealer specified for insulation type used.
6. Insulate floor supports in direct contact with cold surface piping with Armstrong 1/2" thick Armstrong FR/Armaflex pipe or sheet insulation as required by surface. Insulate supports from pipe to floor plate end seal insulation joints with Armstrong No. 520. Finish insulation with Armstrong Armaflex vinyl lacquer finish.

PIPING INSULATION SCHEDULE

Service	Size	Type	Thickness
Domestic Cold Water	0.5"-2"	Fiberglass	1"
Domestic Cold Water	2"-Larger	Fiberglass	1.5"
Domestic Hot Water	0.5"-2"	Fiberglass	1"
Domestic Hot Water	2"-Larger	Fiberglass	1.5"
Domestic Hot Water Recirculation	All	Fiberglass	1"
Air Conditioning Condensate Drain	All	Fiberglass	1/2"
Refrigerant Suction Lines (Interior)	All	Elastomeric	1/2"
Refrigerant Suction Lines (Exterior)*	All	Elastomeric	1/2"

PART 3 - EXECUTION

- 3.1 Install insulation over clean dry surfaces with joints firmly butted together. Insulation at equipment, flanges, fittings, etc., shall have straight edges with box type joints with corner beads as required. Where plumbing and heating insulation terminates at equipment or unions, taper insulation at 30 degrees angle to pipe with one coat finishing cement and finish same as fittings. Total insulation system shall have neat smooth appearance with no wrinkles, or folds in jackets, joint strips or fitting covers. Seal butt joints at maximum intervals of 45 feet to prevent vapor barrier failures from being transmitted to adjoining insulation sections.
- 3.2 Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
- 3.3 All pipe insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- 3.4 Insulation of removable heads and valves, manholes access covers, HVAC and plumbing pumps, etc., shall be fabricated to allow removal without damage to insulation. Provide removable units with vapor-proof cover fabricated to be sealed to equipment vapor barrier.
- 3.5 Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at the Contractor's expense at not cost to Owner.

END OF SECTION 220800

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SECTION 220850 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

- a) Provide necessary materials and accessories for installation of interior and exterior ductwork insulation as specified and/or details on drawings. Insulation type and thickness for specific ductwork systems shall be as listed in Insulation Schedule in Section 15B of this specification.
- b) Provide insulation materials manufactured by Armstrong Cork Co., CertainTeed/Saint Gobain.
- c) Insulation and application adhesives, except where specified otherwise, shall have fire and smoke hazard rating as tested by ASTM E-84 procedure not exceeding:

FLAME SPREAD	25	
SMOKE DEVELOPED		50
FUEL CONTRIBUTED		50

- d) Abbreviations for manufacturers of adhesives, insulating cements and coating specified shall be C.M. for Chicago Mastic Company, B.F. for Benjamin Foster Company and 3M for 3M Company. Average thermal conductivity is expressed in BTU/Hr./Sq.Ft./degrees F/In.
- e) Install interior duct liner insulation cut to insure tight fitting corner, and longitudinal joints. Apply liner to sheet metal with 100% coverage of C.M. No. 17-477, B.F. No. B1-18 or 3M manufacturers recommended applications rate. Coat all edges of liner with adhesive. Provide mechanical fasteners on surfaces 18" or wider in addition to liner adhesive with fastener clips set flush with duct liner surface. Provide fasteners as follows:
 - 1. Low Velocity Ductwork (Velocities less than 2000 FPM): Provide fasteners within 3" of leading edge of each section 12" O.C. around joint perimeter and 3" from longitudinal joints 12" O.C. Elsewhere space fasteners 18" O.C. except not more than 6" from longitudinal joints nor 12" from corner break.
- f) Provide concealed rectangular or round ductwork with exterior thermal insulation of type and thickness listed in schedule. Apply insulation to duct with C.M. No. 17477 or B.F. No. 85-20 adhesive. Provide mechanical fasteners 18" O.C. on duct width 30" and greater. Butt insulation joints tightly together and lap facing 2" over adjacent insulation and seal with vapor barrier adhesive. Seal all breaks with vapor barrier adhesive and vapor barrier tape matching insulation facing.
- g) Provide exposed rectangular ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply with mechanical fasteners spaced 12" O.C. with minimum of two rows per duct side. Seal fasteners, joints, breaks, and punctures with vapor barrier adhesive reinforced with 3" wide vapor barrier tape matching insulation facing.
- h) Provide exposed round sheet metal ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply insulation with joints tightly butted together with vapor barrier adhesive. Insulate fittings with insulation thickness equal to adjoining insulation with cover overlapping 2" onto adjacent covering.
- i) Duct insulation materials by type shall be as follows:

1. TYPE 1-DIL: Internal acoustical and thermal duct insulation for low velocity ductwork shall be Certain Teed 3.0 lb. density Ultralite 300 duct liner with .021 average air friction and .23 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.
2. TYPE 2-DIH: Internal acoustical and thermal duct insulation for high velocity ductwork shall be Certain Teed 3.0 lb. density Ultralite 300 duct liner with .022 average friction co-efficient and .22 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.
3. TYPE 3-DEB: External thermal insulation for rectangular duct Certain Teed 3.0 lb. density 1 B 300 insulation board with FSK vapor barrier facing and .22 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.
4. TYPE 4-DEW: External thermal insulation for rectangular or round duct shall be Certain Teed 1.0 lb. density standard duct insulation type IV with foilscrip-kraft facing and .27 BTUH thermal conductivity at 75 degrees F mean temperature. Facing shall have a maximum vapor transmission rate of 0.02 perms.
5. TYPE 5-DEW: External fireproofing for rectangular or round kitchen exhaust duct systems shall be Great Lakes Textiles, Inc. 1.5" thick Firestop Blanket made of calcined Kaolin. The blanket shall be faced with aluminum foil on both sides. Provide kitchen exhaust duct systems with two layers of the 1.5" thick Firestop Blanket. Installation and Materials shall be in complete accordance with the manufacturer's requirements for grease ducts.
6. TYPE 6-DEW: External thermal insulation for rectangular or round duct shall be 2" rigid Styrofoam square edge per ASTM C578, with applied vapor retarder jacket wrapped with a 16-mil thick aluminum stucco embossed jacket and sealed watertight. Equals by prior approval only.

DUCTWORK INSULATION SCHEDULE

System	Type	Thickness
Supply Air - Rectangular - Low Velocity	1-DIL	1/2"
Supply Air - Round	4-DEW	1 1/2"
Supply Air - Exterior - Rectangular	6-DEW	2"
Return Air - Rectangular	1-DIL	1/2"
Return Air - Round	4-DEW	1 1/2"
Return Air - Exterior - Rectangular	6-DEW	2"
Exhaust Air - Rectangular	1-DIL	1/2"
Exhaust Air - Round	None	-
Outdoor Air - Rectangular	4-DEW	1 1/2"
Outdoor Air - Round	4-DEW	1 1/2"

PART 3 - EXECUTION

- a) Ductwork scheduled for internal lining is NOT sized on the drawings to include the lining. Size shown on the drawings is the inside duct measurement.

END OF SECTION 220850

SECTION 221100 - GENERAL-DUTY VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 VALVES AND INSTALLATION

- A. Valves 2-1/2" and smaller shall have solder, socket weld, flanged or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange end connections or butt weld ends as scheduled. Optional grooved valves may be used where scheduled.
- B. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Architect-Engineer, non-rising stem valves may be installed at particular points where space is restricted.
- C. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
- D. Valves shall be the same size as piping shown on drawings. Do not reduce valve size.
- E. Valves shall be designed for repacking under pressure when fully opened and backseated.
- F. Equivalent gate and plug valves listed on current comparison charts of specified valve manufacturers by Anvil, Crane, Centerline, Nibco, Fairbanks, Hale, Stockham, Jenkins, Kennedy, Keystone, Powell, Walworth or Victaulic will be acceptable.
- G. Equivalent silent check valves listed on current comparison charts of specified valve manufacturers by Anvil, Combination Pump Valve Co., Pagent, Nibco, Stockham, Williams Hager, Mission or Victaulic will be acceptable.

2.2 VALVES

- A. Ball valves shall be scheduled as Type "BLV" valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
BLV-1	3" valves and smaller, Crane bronze full port ball valve 600 PSI-WOG, teflon seats, stainless steel ball, stem with insulated handle (model no. 9303-S), with screwed ends.

- B. Plug valves shall be scheduled as type PLV valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
PLV-1	1 " valves and smaller Hays 7400 series iron body gas cock, 175 PSI-WOG bronze plug washer and nut, screwed ends.

PLV-2 1-1/4" thru 2-1/2" valves, Homestead Fig. 651, semi-steel lubricated plug valve, 200 PSI-WOG, coated plug, short pattern screwed ends. Provide complete with standard pattern cast handle.

VALVE SCHEDULE

Service	Size	Stop	Check	Balance
Domestic Water	Up to 3"	BLV-1	SCV-1	BAV-1
Domestic Water	2 1/2" & Up	-	SCV-2	-
Natural Gas	Up to 1"	PLV-1	-	-
Natural Gas	1 1/4" to 2 1/2"	PLV-2	-	-

PART 3 - EXECUTION

3.1 VALVES AND INSTALLATION

- A. Install necessary valves within piping systems to provide required flow control and to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
- B. Install each valve so that it is easily accessible for operation, visual inspection, and maintenance.
- C. Install globe valves with pressure on top of disc except where prevented by code. Globe valves installed in lines that must be completely drained for inspection, maintenance or to prevent freezing shall be installed with stem in horizontal position to insure complete drainage of pipe lines.
- D. Gate valves shall not be installed in pipe lines where intended service is throttling service or where piping is subject to vibration as part of normal operation conditions.

END OF SECTION 221100

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

- A. PE: Polyethylene plastic.
- B. PP: Polypropylene plastic.
- C. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- G. NSF Compliance:
1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Copper, Pressure-Seal Fittings:
 - a. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L, water tube, drawn temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Copper, Pressure-Seal Fittings:
 - a. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - b. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D 2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 200 psig (1380 kPa).
1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig (1380 kPa).
1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig (1380 kPa).

2.4 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.
1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
- B. PVC, Schedule 80 Pipe: ASTM D 1785.
1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- C. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.
1. Comply with UL 1285 for fire-service mains if indicated.
 2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

- a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.B, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:

- a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig (1725 kPa).
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

3. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

- a. Description: Cast- or ductile-iron body end bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. UL/FMG, Nonrising-Stem Gate Valves:

- a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Flanged.

2. OS&Y, Rising-Stem Gate Valves:

- a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig [1207 kPa].
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

1. OS&Y, Rising-Stem Gate Valves:

- a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig [1207 kPa].
 - 3) End Connections: Threaded.

2. Nonrising-Stem Gate Valves:

- a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches [125 mm] in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- B. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 CORPORATION VALVES AND CURB VALVES

- A. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches [75 mm] in diameter.

1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.9 WATER METERS

- A. Water meters will be furnished by utility company.
 - a.

2.10 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
 1. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standard: AWWA C502.
 - b. Pressure Rating: 250 psig (1725 kPa).
 2. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standards: UL 246, FMG approved.
 - b. Pressure Rating: 250 psig (1725 kPa).
 - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
 - e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
 - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated..

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

- E. Underground water-service piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be any of the following:
 - 1. Soft copper tube, ASTM B 88, Type K copper, pressure-seal fittings; and pressure-sealed joints.
 - 2. PE, ASTM pipe; insert fittings for PE pipe; and clamped joints.
 - 3. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
- F. Water Meter Box Water-Service Piping NPS 3/4 to NPS 3 (DN 20 to DN 80) shall be same as underground water-service piping.
- G. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be any of the following:
 - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
 - 2. PVC, AWWA C900 Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 (DN 50) and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 - 2. Underground Valves, NPS 4 (DN 100) and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- C. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- E. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
 - 1. Under Driveways or Roads: With at least 36 inches (910 mm) cover over top.
- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

- G. Extend water-service piping and connect to water-supply source and building-water-piping systems at 5 feet outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at 5 feet outside building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 - 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 - 6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM O 3139 and pipe manufacturer's written instructions.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained-joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Heat-fused joints.
 - 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.10 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to service connection points provided by water utility company for both domestic and fire suppression lines.
- C. Connect water-distribution piping to interior domestic water and fire-suppression piping 5 feet outside building..

3.11 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.12 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.13 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

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SECTION 221400 - PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 1 - PRODUCTS

1.1 PIPING IDENTIFICATION

- A. Lettering on marker shall be at least 1-inch high block type in contrasting color. An arrow indicating flow direction shall be painted next to each marker. Where markers occur on parallel groups of piping they shall be neatly lined up.
- B. See Piping Identification Schedule.

PIPING IDENTIFICATION SCHEDULE

Service	Letter Wording	Marker Color	Letter Color
Domestic Cold Water	Domestic Cold Water	Green	White
Domestic Hot Water	Domestic Hot Water	Yellow	Black
Domestic Hot Water Return	Hot Water Return	Yellow	Black
A/C Condensate Drain	Drain	Green	White
Fire Sprinkler Water	Fire Sprinkler Water	Red	White

1.2 PIPING MATERIALS AND FITTINGS

- A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. All materials listed may not be required on this project. See piping material schedules in Section 22 of this specification for materials to be used for each piping system. Piping materials shall be as follows:
 - 1. Hubless Cast Iron Soil Pipe:
 - a. Pipe and fittings shall be gray cast iron with spigot bead and positioning lug. Pipe and fittings shall be coated inside and out with asphaltum preservative and shall meet requirements of current Cast Iron Soil Pipe Institute Standard 301-69T.
 - b. Pipe joints shall be no-hub joint couplings consisting of neoprene rubber sleeve, stainless steel shield and clamp assembly.
 - c. Pipe and fittings by Tyler Pipe, Charlotte or Central Foundry.
 - 2. Carbon Steel Pipe (1/8" through 2-1/2"):
 - a. Provide continuous weld or electric resistance welded carbon steel pipe conforming to ASTM Specification A-120 or A-53 as scheduled.
 - b. Pipe joints shall be threaded conforming to ANSI Standard B2.1.
 - c. Pipe by Armco, Youngstown, United States Steel or equal.
 - 3. Polyvinyl Chloride (PVC) Pipe:

- a. Provide Type 1, Grade 1, Polyvinyl Chloride Pipe conforming to requirements of current ASTM Specification D-1785 for pressure piping as scheduled. Pipe shall be approved by National Sanitation Foundation (NSF) for potable water.
 - b. Provide Type 1, Grade 1, Polyvinyl Chloride Pipe conforming to requirements of current ASTM Specification D-2665 for DWV piping as scheduled. Cellular core PVC piping will not be approved.
 - c. Pipe for pressure piping shall have plain ends for socket type fittings.
 - d. Pipe by Chemtrol, Charlotte, Tyler or equal.
4. Copper Tube:
- a. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L or M as listed in schedule.
 - b. Tubing joints shall be soldered or brazed, See schedule for joining method to be used.
 - c. Pipe by Cerro, Chase, Mueller, Revere Copper or equal.

1.3 PIPING FITTINGS

- A. Piping fittings used throughout project shall be proper type for installation method used and shall be compatible with piping system materials. Fittings listed in piping material schedule shall conform to the following specifications:
- 1. Carbon Steel Welding Fittings:
 - a. Provide Carbon Low Alloy Seamless Steel Welding Fittings conforming to current ANSI Standard B16.9 and ASTM Specification A234.
 - b. Fittings by Anvil, Midwest or equal.
 - 2. Branch Connection Welding Fittings:
 - a. Provide carbon steel Weldolet fittings conforming to ANSI Standards B16.9, B16.11, B31.1.0 and ASTM Specification A105 grade 11.
 - b. Fittings by Bonney Forge or equal.
 - 3. Branch Connection, Welding to Screwed Fitting:
 - a. Provide carbon steel Thredolet fitting conforming to ANSI Standards B16.9, B16.1 1, B31.1 and ASTM Specification A105 Grade 11.
 - b. Fittings by Bonney Forge or equal.
 - 4. Carbon Steel Flanges:
 - a. Provide carbon steel flanges conforming to ASTM Specification A181 Grade 1 and ANSI Standard B16.5.
 - b. Flanges by Anvil, Midwest or equal.
 - 5. Malleable Iron Screwed Fittings:
 - a. Provide screwed malleable iron fittings conforming to ANSI Standard B16.3, B2.1 and ASTM Specification A-47 grade 32510.
 - b. Fittings by Crane, Anvil, Stockham or equal.
 - 6. Cast Iron Screwed Fittings:

- a. Provide screwed cast iron fittings conforming to ANSI Standard B16.4, B2.1, and ASTM Specification A-126, Class A.
 - b. Fittings by Crane, Anvil, Stockham or equal.
- 7. Wrought Copper Fittings:
 - a. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22.
 - b. Fittings by Chase, Nibco or equal.
- 8. Cast Bronze Fittings:
 - a. Provide cast bronze solder joint fittings conforming to ANSI Standard B16.1B.
 - b. Fittings by Chase, Nibco or equal.
- 9. PVC, DWV Fittings:
 - a. Provide PVC, DWV socket fittings conforming to ASTM D-3311 and D-2661.
 - b. Solvent cement of socket fittings shall conform to ASTM D-2235.
 - c. Fittings by Chemtrol, Charlotte, Tyler or equal.

1.4 INSULATING UNIONS AND FLANGES

- A. Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturer's name and pressure class rating. Unions and flanges shall be as follows:
 - 1. Iron or steel pipe to copper pipe:
 - a. Provide Epco dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.

1.5 STRAINERS

- A. General: Provide Zurn "Y" type self-cleaning strainers with FIPT blow-off outlet, flanges or screwed end with pressure rating as required by piping system. Provide strainers with removable stainless steel or monel screens with perforations as follows:

TYPE OF SERVICE	STRAINERS SIZE, INCHES			
	1/4 to 2	2 1/2 to 6	8 to 24	
Water	.005	1/16	1/8	

- B. Equivalent strainers by Armstrong, Metraflex, Trane, Nibco, Victaulic or Spirax Sarco.

1.6 UNIONS

- A. Provide Stockham brass seat unions of material and pressure rating required by piping system.
- B. Equivalent union by Metraflex, Grinnell or equal.

PART 2 - EXECUTION

2.1 PIPING IDENTIFICATION

- A. Identify piping in mechanical rooms, open pipe chases, tunnels, and other places where piping is accessible for operation and maintenance by painting with identification colors and with pressure sensitive pipe markers.
- B. Place piping markers so they can be easily read from operating position and floor.
- C. Mark piping with marker and a 3-inch wide band of identification color around circumference of pipe in lieu of painting complete pipe or pipe covering.

2.2 STRAINERS

- A. Install strainers upstream from automatic control valves, steam traps and pumps. Where strainers are an integral part of these items or incorporated in accessory equipment directly upstream, individual line strainers will not be required. Strainers shall be same size as piping. Provide strainers with proper isolation and blow down valves to allow basket removal for cleaning.

2.3 UNIONS

- A. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.
- B. Where piping systems of dissimilar materials are jointed together provide proper insulating union as specified under this specification.

2.4 PIPING INSTALLATION

- A. Pipe sizes indicated on plans and as specified refer to nominal size in inches for steel pipe, cast iron pipe and copper tubing, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.
- B. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings. Verify construction types and provide proper hangers, inserts and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturers recommendations for fixed hanger and supports. Provide copper plated hangers and supports for suspension of uninsulated copper tubing lines.
- C. Install all piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. All piping shall be concealed unless noted otherwise. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
- D. Provide piping materials and wall thickness for specific piping systems as listed in piping schedules on drawings. Steel piping systems 2-1/2" under shall be threaded pipe and fittings. Steel pipe systems 3" and above shall be weld end pipe and fittings unless required otherwise by Code.
- E. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line. Provide unions on identical sizes of equipment for which one replacement item to be installed between unions without making any piping changes.
- F. Piping fitting materials for specific piping systems shall be as listed in piping schedule. Fittings shall be approved factory made type with threaded or weld ends as required. Fitting pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitared or field fabricated pipe fittings will be permitted.

- G. All pipe threads shall meet ANSI Standard B2.1 for taper threads. Lubricate pipe threads with Astroseal teflon thread sealant and lubricating compound applied full strength. Powdered or made up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.
- H. Welded pipe joints shall be made by qualified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe fitting ends shall be beveled a minimum of 30 degrees prior to welding.
- I. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
- J. Soft soldered socket type joints shall be made in with 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket joints shall be limited to systems containing nonflammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock or vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.
- K. Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings 2-1/2" and smaller shall be threaded type, pipe and fittings 3" and larger shall be weld type. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

2.5 TESTING PROCEDURES

- A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
- B. Where entire system can not be tested before concealment, test system in sections. Upon completion, each system shall be tested as an entire system.
- C. Repair or replace defects, leaks and materials failures revealed by tests and then retested until satisfactory. Make repairs with new materials.
- D. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings remove or isolate components from system during tests.
- E. Test methods and pressures shall be as follows:
 - 1. Hydrostatic Test (Closed Systems):
 - a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.
 - 2. Hydrostatic Test (Open System):
 - a. Test entire system with 10 foot head of water. Where system is tested in sections each joint in building except uppermost 10 feet of system shall be submitted to at least 10 feet head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.
 - 3. Pneumatic Test:
 - a. Test entire system with compressed air. Systems operating above 2 PSI shall be tested at 75 PSI or 150% of operating pressure or whichever is greater.
 - b. Allow at least 1 hour after test pressure has been applied before making initial test.
 - c. During test, completely isolate entire system from compressor or other sources of air pressure.
 - 4. Pressure Relief and Safety Valve:

- a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
 - b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
 - c. Items installed in systems without test tag attached will be rejected.
- F. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
- G. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
- H. For test pressures see Piping Material Schedule on drawings.

2.6 PIPING PROTECTIVE COATING

- A. Prepare and coat field made pipe joints and make coating repairs according to manufacturer's recommendation. Cover joints with shrinkable polyethylene sleeve. Coated piping passing through pipe sleeve shall have double thickness coating through sleeve.

END OF SECTION 221400

SECTION 221500 Geothermal Well Field Systems

PART 1 - GENERAL

- A. The well field contractor is responsible for all aspects involved with the complete geothermal well field installation. All materials, drilling, excavation, hauling of backfill, pumping, soil compaction and labor required shall be included in the bid price.
- B. The well field contractor shall take note: there is no guarantee to the well field contractor that the location of any existing utilities are exactly as indicated on the plans. Some areas may require hand digging to locate that utility. The well field contractor must include in the bid price, the repair of any domestic water, electrical, communication or any service line that may be damaged during the construction of this project. Any offsets required to route over or under existing lines shall also be included in the bid price of the project.
- C. Provide all material as specified in this Section.

PART 2 - QUALIFICATIONS

- A. The well field contractor must be an International Ground Source Heat Pump Association (IGSHPA) certified installer. The well field contractor performing this work must have a minimum of two years experience in performing underground geothermal closed loop vertical heat exchanger (VHE) work of this project's size or larger. Prior to any borehole drilling and well field pipe installation, the contractor shall obtain the appropriate Missouri Department of Natural Resources permit.
- B. VHE fabricators must be heat fusion certified by an authorized high density polyethylene (HDPE) pipe manufacturer's representative of the brand of pipe used. Certification must include: successful completion of a written heat fusion exam as well as demonstrating proper heat fusion techniques under the direct supervision of the authorized HDPE pipe manufacturer's representative.

PART 3 - PRODUCTS

- A. Pipe
 - 1. The pipe shall be high density polyethylene (HDPE) pipe, PE3408 HDPE with a minimum cell classification of 45434C per ASTM D3035-93 and a SDR11 (160 psi) rating for u-bends and header pipe 2 inches or smaller and a minimum of DR15.5 (110 psi) for header pipe greater than 2 inch in diameter. The material shall maintain a 1600 psi hydrostatic design basis at 73.4 degrees F. per ASTM D-2837. The pipe will carry a warranty of no less than 25 years.
 - 2. Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture.
 - 3. All piping used for VHE will have factory hot-stamped lengths impressed on the side of the piping indicating the length of the VHE at that point. The length stamp shall read zero on one end and the actual VHE total length on the other end.
 - 4. The VHE will have a factory fused u-bend with pipe lengths long enough to reach grade from the bottom of the bore so no field fusions are required below the header pit.
- B. Manholes/Headers
 - 1. The manhole structure should be glass fiber reinforced concentric manhole or a reinforced concrete manhole with a cast iron manhole cover.
 - 2. All manifold header and circuit piping shall be HDPE pipe, joined together with heat fusion. All of the manhole's circuits include valves and pressure/temperature ports for complete isolation, pressure testing and flow balancing.
- C. Fittings

1. Pipe fittings shall meet the requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacturer.

D. Bentonite Grout

1. The thermally enhanced bentonite grout used to seal the VHE shall have a minimum thermal conductivity of 1.20 Btu/hr-ft²-F and a minimum of 71.4% solids. This grout will also have a permeability rate of less than 1X10⁻⁷ cm/sec.

E. Locating Tape

1. Locating tape must be foil backed, two inches wide or greater, with a continuous message printed every 36 inches or less reading: "CAUTION GEOTHERMAL PIPELINE BURIED BELOW". The tape shall be highly resistant to alkalis, acids, and other destructive agents found in the ground.

F. Acceptable Manufacturer's

1. Pipe
 - a) Performance Pipe - Driscoplex 5300
 - b) Centennial Plastics

PART 4 - EXECUTION

A. Drilling

1. The contractor shall obtain all permits as required from state and local authorities. The contractor shall comply with all Missouri Department of Natural Resources (DNR) regulations. For wells over 200 feet deep, the contractor shall obtain the required variance from DNR as per the written regulations.
2. The vertical boreholes will be drilled to a depth that allows complete insertion of the VHE to its specified depth. The maximum borehole diameter will be six inches. If a larger diameter is required, it must be approved by the design engineer.

B. U-Bend Pipe Assembly

1. The u-bend pipe shall be filled with water and pressured to 100 psi to check for leaks before insertion. If necessary, an iron (sinker) bar can be attached at the base of each u-bend to overcome bouncy. This iron bar will have all sharp edges adequately taped to avoid scarring and/or cutting of the polyethylene pipe. No driving rod that is pulled out after u-bend insertion will be allowed. The entire u-bend pipe assembly is inserted to the specified depth in the borehole.

C. Grouting Procedure

1. The VHE is to be grouted from the bottom up, in a continuous fashion, using a one inch HDPE tremie pipe. The tremie pipe will be pulled out during the grouting procedure maintaining the pipe's end just below grout level within the borehole. All State regulations will be met for borehole grouting of the VHE.

D. Heat Fusion Pipe Joining

1. All underground pipe joining will be heat fused by socket, butt or saddle (sidewall) fusion in accordance to ASTM D2610, ASTM D2683 and the manufacturer's heat fusion specifications. The operator shall be heat fusion certified and experienced in executing quality fusion joints.

E. Excavation and Backfilling for Piping

1. The well field contractor shall do all excavating, backfilling, shoring, bailing and pumping for the installation of his work and perform necessary grading to prevent surface water from flowing into trenches or other excavations. Sewer lines shall not be used for draining trenches. All pipe and conduit ends shall be kept sealed and lines left clean and unobstructed during construction. Only material

suitable for backfilling shall be piled a sufficient distance from banks of trenches to avoid overloading. Unsuitable backfill material shall be removed as directed by the design engineer.

2. Sheathing and shoring shall be done as necessary for protection of work and personnel safety. Unless otherwise indicated, excavation shall be open cut except for short sections. The well field contractor shall install geothermal locating tape 18 inches above all horizontal/header piping.
3. Prior to drilling or trenching, the well field contractor shall be responsible for reviewing with the general contractor the location of underground utilities. Existing utility lines uncovered during excavation shall be protected from damage during excavation and backfilling.

F. Pipe Installation

1. The u-bend pipe ends will be sealed with fusion caps or tape prior to insertion into the borehole. Reasonable care shall be taken to ensure that the geothermal well field pipe is not crushed, kinked, or cut. Should any pipe be damaged, the damaged section shall be cut out and the pipe reconnected by heat fusion.
2. The VHE's must be connected as indicated on the plans. The header design accounts for balanced flow as well as flushing and purging flow rates. The minimum bend radius for each pipe size shall be 25 times the nominal pipe diameter or the pipe manufacturer's recommendations, whichever is greater. The depth of all headers and supply and return piping is indicated on the plans and must be maintained.
3. Circuits will be pressure tested before any backfilling of the header trenches is executed. The individual circuits will be pressure tested with water at 60 psi, however, not to exceed DR 11 pipe working pressure at bottom of the u-bend pipe.

G. Testing and Cleaning

1. Cleaning

- A. During installation, all debris, and small animals shall be kept out of the pipe. Ends of the HDPE pipe shall be sealed until the pipe is joined to the circuits.

2. Flushing and purging

- A. Each supply and return circuit shall be flushed and purged with a water velocity of two feet per second. The lines shall be left filled with clean water and then pressure tested. If connection to the manifold is not immediate, piping must be capped. The well field contractor must coordinate antifreeze solution installation with the mechanical contractor. The mechanical contractor is responsible for the antifreeze solution. See mechanical specifications for antifreeze.
3. After the period of these operations, any defects or damages that may have developed in the equipment and apparatus as a result of the cleaning process or the operation of the system shall be repaired.

END OF SECTION 221500

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SECTION 221850 HYDRONIC PUMPS

PART 1 - GENERAL:

- A. Provide pumps and required system trim for geothermal condenser water systems including all related appurtenances for a complete and operating systems.
- B. Provide one (1) set of mechanical seals for each model type of primary pump scheduled.

PART 2 - PRODUCTS:

- A. Furnish and install new end suction long coupled pumps for geothermal condenser water systems as indicated on the drawings. Pumps shall be Model 1510 or 90 as manufactured by Bell & Gossett or equal by Armstrong. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the drawings.
- B. The pumps shall be long coupled, base mounted, single stage, end suction, vertical split case design, in cast iron bronze fitted (or all bronze or all iron) construction specifically designed for quiet operation. Suitable standard operations at 225F and 175 PSIG working pressure or optional operations at up to 250F and 250 PSIG working pressures. Working pressures shall not be de-rated at temperatures up to 250F. The pump internals shall be capable of being serviced without disturbing piping connections, electrical motor connections or pump to motor alignment.
- C. The pumps shall be composed of three separable components a motor, bearing assembly, and pump end (wet end). The motor shaft shall be connected to the pump shaft via a replaceable flexible coupler.
- D. A bearing assembly shall support the shaft via two heavy-duty regreaseable ball bearings. Bearing assembly shall be replaceable without disturbing the system piping and shall have foot support at the coupling end. Pump bearings shall be regreaseable without removal of the bearings from the bearing assembly. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.
- E. The bearing assembly shall have a solid SAE1144 steel shaft. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.
- F. Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Application of an internally flushed mechanical seal shall be adequate for seal flushing without requiring external flushing lines. Seal assembly shall have a brass housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.
- G. Bearing assembly shaft shall connect to a bronze impeller. Impeller shall be both hydraulically and dynamically balanced to ANSI/HI 1.1-1.5-1994, section 1.4.6.1.3, figure 1.106, balance grade G6.3 and keyed to the shaft and secured by a stainless steel locking cap screw or nut.
- H. A center drop-out type coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupler sleeve. Coupler shall allow for removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections. On variable speed applications the coupler sleeve should be constructed of an EPDM material to maximize performance life.
- I. An ANSI and OSHA rated coupler guard shall shield the coupler during operation. Coupler guard shall be dual rated ANSI B15.1, Section 8 and OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling. No more than .25 inches of either rotating assembly shall be visible beyond the coupling guard.
- J. Pump volute shall be of a cast iron design for heating systems with integrally cast pedestal volute support, rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges. Volute shall include gauge ports at nozzles, and vent and drain ports.
- K. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned after installation. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications and conform to the standards outlined in EPACT 92.

- L. Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area (for field grouting). The minimum base plate stiffness shall conform to ANSI/HI 1.3.4-1997 for *Horizontal Baseplate Design* standards.
- M. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 1.1-1.5-1994, section 1.4.6.1.1 for recommended acceptable unfiltered field vibration limits (as measured per H.I. 1.4.6.5.2, Figure 1.10B) for pumps with rolling contact bearings. Pump manufacturer shall be ISO-9001 certified.
- N. Each pump shall be factory tested and name-plated before shipment.
- O. Pump shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer. The pump NPSH shall conform to the ANSI/HI 9.6.1-1997 standards for *Centrifugal and Vertical Pumps for NPSH Margin*.

END OF SECTION 221850

SECTION 221890 HVAC WATER TREATMENT

PART 1 - GENERAL

- A. Provide the geothermal condenser water systems with corrosion and microbial growth inhibitors only.
- B. Glycol shall not be required.

PART 2 - FLUID MATERIAL

- A. The fluid must be a non toxic blend intended to be further be diluted with water.
- B. The fluid must be dyed [fluorescent pink or fluorescent yellow] to facilitate leak detection.
- C. When properly formulated the finished product should contain Dipotassium Phosphate @ 2500 ppm, Borax 5 mol as Boron @ 150 ppm, and Sodium Tolytriazole @ 150 ppm.
- D. The fluid must be easily analyzed for concentration and inhibitor level, and easily reinhibited using replacement inhibitor readily available from the fluid manufacturer.
- E. For a system containing more than 250 gallons of fluid, annual analysis must be provided free of charge by the fluid manufacturer. Manufacturer must also provide testing guidelines for use by the operator of a smaller system.
- F. The fluid must pass ASTM D1384 [less than 0.5 mils penetration per year for all system metals].
- G. Fluid shall be equal to Intercool NFP manufactured by Interstate Chemical.

PART 3 - INSTALLATION

- A. Clean piping systems with a 1% to 2% solution of trisodium phosphate in water prior to the installation of propylene glycol.
- B. Use only deionized water in solution with the propylene glycol fluid.

END OF SECTION 221890

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SECTION 223000 - FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

1.2 GENERAL

- A. Hereinafter, all reference to "this contractor", "the contractor", etc., unless specifically preceded by a trade category, shall apply to the Sprinkler Contractor.

1.3 SCOPE

- A. Furnish all design, labor, materials, fabrication, equipment, and services necessary to provide a complete and operational automatic fire sprinkler system as specified herein and as required for satisfactory operation of the system.
- B. The sprinkler system shall be installed in accordance with the latest edition of NFPA. This requirement does not relieve the contractor from meeting the requirements set by Factory Mutual. All flow indicators, gongs, horns, etc. shall be included as part of this contract.
- C. Provide an automatic dry-pipe sprinkler system in all unconditioned spaces where fire sprinkler is required such as the exterior canopies. The fire sprinkler engineer shall be responsible for determining all areas that require protection. Coordinate with Electrical Contractor to provide power to dry-pipe system air compressor. Contractor shall be responsible for increases in conduit, conductor, and equipment as required for the dry-pipe system.

1.4 FEES AND PERMITS

- A. The contractor shall secure and pay for all permits, licenses and inspections necessary in conjunction with this work. In addition, the contractor shall pay for all tap fees and equipment costs associated with the fire sprinkler system.

1.5 PROTECTION OF WORK

- A. Sprinkler Contractor shall take the necessary precautions required to protect his work as well as the work of other trades against any damages.

1.6 SUBMITTALS AND APPROVALS

- A. All material submitted shall be contained in brochure type binders, clearly labeled and identified. Each submittal shall be complete, with all items listed in schedule form, showing type, manufacturer, catalog number, finish shop drawings or descriptive literature for the purpose of identifying the equipment and engineer's reference number. Failure to comply with these requirements will result in return of submittal for resubmission.
- B. Contractor shall submit scaled layout drawings including, but not limited to, head locations, pipe sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Indicate interface and spatial relationships between piping and proximate equipment. Shop hanger locations. Plans shall be submitted prior to A/E for head locations approval.
- C. At project closeout, submit 3, 1/8" scaled, dimensioned, record drawings to the A/E of installed fire protection piping and equipment.

- D. AutoCAD drawings are available by request and will require a fee of \$50 per sheet.
- E. The sprinkler system shall be a complete system as required by local authorities. All wiring required for the system shall be provided by the sprinkler contractor and shall be included in the submittal package. Submit to Agency having jurisdiction for approval. Submit one approved copy, bearing stamp and/or signature of Agency having jurisdiction, before proceeding with installation.
- F. Submit certification upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13, NFPA 13R and NFPA 14, as applicable, and also that system is operational, complete, and has no defects.

1.7 CODES AND ORDINANCES

- A. The Contractor shall comply with all requirements, regulations, code, ordinance, ruling or Fire Underwriters' requirements, NFPA, and Factory Mutual applicable to this class of work. Furthermore, they shall include but shall not be limited to, codes listed in other sections of these specification.
- B. Provide fire protection products in accordance with UL standards: provide UL label on each product.
- C. Install fire protection systems in accordance with local regulations of fire department or fire marshal. Comply with local Fire Department/Marshal regulations for sizes, threading and arrangement of connections for fire department equipment to standpipe systems.

1.8 QUALIFICATION OF SPRINKLER CONTRACTOR

- A. Fire protection work shall be installed by a firm with at least 3 years of successful installation experience on projects with the fire protection work similar to that required for project.
- B. Designs and calculations shall be performed under direct supervision of and properly sealed and signed by a Registered Professional Engineer licensed in the state in which the project is located.

1.9 WATER SERVICE

- A. Contractor shall include in his bid the installation of the required underground water service line at the location(s) indicated on the drawing. The contractor must consult the City Water department and local authorities, provide necessary materials and labor to conform with all local requirements and include the cost of all work and materials in connection with the service. This contractor shall perform necessary hydraulic calculations required to size the line in accordance with applicable provisions of NFPA including NFPA 13.

1.10 DESIGN AND CALCULATION

- A. Contractor shall perform necessary calculations required for proper design and installation of the sprinkler system for the entire building (existing and addition). All design calculations and layout of the sprinkler system network shall be based on the Specifications and accompanying drawings. Request for HVAC duct and equipment relocations shall be submitted to the Engineer one week before the bid opening date. No sprinkler pipe penetration will be allowed through HVAC duct system.
- B. Refer to fire hydrant flow test data taken near project site attached at the end of this section.

1.11 ELECTRICAL REQUIREMENTS

- A. Electric tamper switches may not be shown but are required wherever a shutoff valve is installed in the sprinkler system. The sprinkler contractor shall be responsible for providing the tamper switch and associated wiring to connect to the fire alarm system. All wiring shall be in accordance with Division 26. Coordinate requirements with fire alarm contractor.

- B. Electric flow switches may not be shown but are required. The sprinkler contractor shall be responsible for providing the flow switch and associated wiring to connect to the fire alarm system. All wiring shall be in accordance with Division 26.
- C. All flow switches, gongs, horns, etc. required by the local code officials or authority with jurisdiction shall be included. All wiring shall be in accordance with Division 26. Coordinate requirements with fire alarm contractor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Viking, Reliable or approved equal. Substitutions are subject to approval based on appearance, quality, function, etc.

2.2 EQUIPMENT AND MATERIALS

- A. All materials and equipment furnished as part of this contract shall be UL listed, Factory Mutual approved and in compliance with applicable provisions of the NFFA.
- B. No plastic piping will be allowed.

2.3 SPRINKLER HEADS

- A. Unless indicated otherwise, sprinkler heads shall be as follows:
 - 1. Exposed Areas Without Ceiling Brass, Unplated Sprinklers.
 - 2. Finished Ceiling Areas: Concealed mount brass, unplated sprinklers with cover plate and trim in finish as selected by architect.
- B. Temperature rating of fusible plug or link of sprinklers shall be appropriate for the ambient conditions in the immediate areas.

2.4 SPARE HEADS

- A. Contractor shall furnish spare sprinkler heads identical to each type installed in accordance with the following schedule:

# Installed	of Spares
Less than 300	6
More than 300	12
- B. Spare sprinkler head shall be mounted in emergency sprinkler cabinet. Cabinet shall be located in Mechanical room. See drawings for location.

2.5 SIAMESE CONNECTIONS

- A. Contractor shall provide Siamese type connection through exterior building wall where shown on plan. Coordinate the exact location, pipe threads and fittings with the local fire department to ensure exact match.

PART 3 - EXECUTION

3.1 TESTING AND FLUSHING OF SYSTEM

- A. All piping shall be hydrostatically tested for a period of two (2) hours at not less than 200 psi pressure. If leaks appear, lines shall be drained, leaks repaired and test repeated. No piping shall be concealed in any manner before being tested and approved.
- B. Tests shall be made in the presence of an inspector from the authorities having jurisdiction. The owner shall be notified of time of all tests in advance of the date.

3.2 MISCELLANEOUS EXECUTION

- A. All sprinkler heads in the main sales area shall be positioned approximately half way between rows of lights and at approximately center of ceiling tile. It shall be the responsibility of the sprinkler designing engineer to accommodate this requirement. Failure to comply with this requirement will result in return of submitted design for resubmission.
- B. All piping shall be installed within 6" of the structure. Offset around obstacles as necessary and return piping to within 6" of structure as close to offset as possible. Branch piping shall be run between concrete stem or steel joists in rooms without ceilings.
- C. Sprinkler heads shall be installed in the center of ceiling tiles.

END OF SECTION 223000

SECTION 224100 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 EQUIVALENT FIXTURES AND ACCESSORIES BY THE FOLLOWING MANUFACTURERS WILL BE ACCEPTABLE

- A. Toilet Seats: Church, Olsonite, Toto, or Beneke.
- B. Fittings and Supports: Josam, Smith, Zurn or Wade.
- C. Traps, Supplies and Stops: Dearborn, Sanitary Oash or as specified under plumbing fixtures.
- D. Supplies and Stops: Dearborn Figure No. 2407CW 1-1/2" compression inlet with angle compression stop and 3/8" O.D. risers in length required. Provide deep chrome plated brass escutcheons.
- E. Traps: Dearborn #FS510 (1-1/2") and/or #FS507 (1-1/4") cast brass body with clean-out "P" trap. Provide deep chrome plated brass escutcheon with set screw.

2.2 REFER TO PLUMBING FIXTURE SCHEDULE ON CONSTRUCTION DRAWINGS FOR FIXTURE TYPES TO BE INSTALLED UNDER THIS SECTION

PART 3 - EXECUTION

3.1 PLUMBING FIXTURES

- A. Provide plumbing fixtures as shown on drawings and as specified complete including piping and connections. China fixtures shall be of best grade vitreous ware, without pit holes or blemishes and outlines shall be generally true. Architect reserves right to reject any piece which in his opinion is faulty. Fixtures fitting against walls shall have ground backs. Exposed piping and fitting shall be chrome plated.
- B. Set fixtures true and level with all necessary supports for fixtures installed before plastering is done. Nipples through wall to fixture connection shall be chrome plated brass. Contractor may use copper stubouts to stops under lavatories provided deep escutcheons are used and no copper is visible in lieu of chrome nipples.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

- E. Install wall-hanging fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
- R. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- S. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
- T. Set shower receptors service basins in leveling bed of cement grout.
- U. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

- A. Connect water supplies from water distribution piping to fixtures.
- B. Connect drain piping from fixtures to drainage piping.
- C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

- D. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224100

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SECTION 224300 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 REFER TO PLUMBING FIXTURE SCHEDULE ON CONSTRUCTION DRAWINGS FOR FIXTURE TYPES TO BE INSTALLED UNDER THIS SECTION.

2.2 FLOOR DRAINS, FLOOR SINKS, ETC.

- A. All floor drains in finished areas shall have chrome plated strainers.
- B. Provide each drain that does not have an integral "P" trap with a cast iron "P" trap in connecting piping.
- C. See Architectural plans for floor drain top elevations and floor drainage.

2.3 CLEANOUTS

- A. Wall Type Finished Areas: PVC cleanout "T" with cleanout plug and stainless steel access cover.
- B. Wall Type Unfinished Areas: Cast iron cleanout tee with countersunk plug.
- C. Floor Type Hard Flooring Areas: Round chrome plated scoriated cover.
- D. Floor Type Carpet Areas: Nickel bronze top and carpet clamp.
- E. Verify floor materials used from Architectural plans.

2.4 SHOCK ABSORBERS

- A. Provide Josam Absorbotron shock absorbers or approved equal on all individual plumbing fixtures and plumbing fixture batteries sized in accordance with the Plumbing and Drainage Institute "Standard P.D.I. WH201 ". Equivalent shock absorbers by Zurn, Wade, Sioux Chief or J.R. Smith.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.

- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
- D. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- E. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- F. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- G. Install floor drains at low points of surface areas to be drained as indicated on construction drawings. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Block out floor prior to pouring of concrete and then level floor drain after pour is set, remove forms and grout hole level.
- H. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- I. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- J. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- K. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- L. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- M. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
- N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 224300

SECTION 224850 - WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

- A. Water heaters shall meet ASHRAE/IESNA 90.1-1999.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 SEALED COMBUSTION GAS FIRED WATER HEATER

- A. The tank construction shall be of high strength steel with a triple pass flue design for increased heat transfer efficiency. The tank shall be constructed in accordance with (Standard/ASME) construction requirements and shall be designed to withstand a hydrostatic test pressure of two times the working pressure without leakage. The tank shall have a working pressure of 150 psi. The tank shall be furnished with a handhole for ease of inspection, cleanout and service. The interior of the tank shall be glass lined and fired to 1600°F to ensure a molecular fusing of glass and steel. The tank shall be furnished with four magnesium anodes to provide electrolytic protection (except 400 which has 2 powered anodes and 1 magnesium anode) and shall carry a three (3) year limited warranty.
- B. The water heater shall be constructed with a heavy gauge steel jacket assembly. The tank shall be completely encased in high density polyurethane foam insulation to maximize heat retention and lower standby heat loss. The exterior of the jacket assembly shall be finished with a 3 coat acrylic enamel finish. The water heater shall be approved for zero clearance to combustible materials.
- C. The water heater shall be equipped with a sealed combustion system for direct venting using PVC or CPVC vent pipe.
- D. The water heater shall have an electronic ignition system and an ASME temperature and pressure relief valve. It shall be factory assembled and tested and require no special calibrations or start up. The water heater shall be approved to provide 180°F water for sanitation, commercial and industrial operation. In the case of an overheat condition the water heater will employ an energy cut off that shuts off all gas.
- E. The entire water heater shall be certified and listed by C.S.A. International under the latest edition of the ANSI Z21.10.3 test standard for water heaters. The water heater shall comply with the energy efficiency requirements for standby loss and thermal efficiency as specified in the latest edition of the ASHRAE 90.1 Standard.
- F. See **WATER HEATER SCHEDULE** on construction drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install commercial water heaters on concrete bases. Omit concrete bases for water heaters installed on a stand, bracket, or suspended platform.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- D. Install thermometer on outlet piping of water heaters.
- E. Fill water heaters with water. Charge expansion tanks with air.
- F. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- G. Coordinate grounding of the water heater with the electrical contractor.

END OF SECTION 224850

SECTION 227330 ENERGY RECOVERY VENTILATORS

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. The ERV unit is an indoor, outdoor, or roof mounted, electronically controlled outdoor air pre-conditioner utilizing an Air Exchange Energy Recovery Cassette to reduce the heating and cooling load placed on the heating and cooling unit by untreated outdoor air. Exhaust air shall be introduced to the ERV unit through a transition connected to the HVAC unit. Supply air shall be introduced to the HVAC unit return air compartment through the integrated "Combo curb", drop-in damper box, or through a field supplied duct connection to the HVAC unit return duct.

1.2 QUALITY ASSURANCE

- A. Unit shall be designed in accordance with UL Standard 1995
- B. Unit shall be ARJ 1060 certified
- C. Unit shall be ETL compliance labeled
- D. Insulation and adhesives shall meet NFPA 90A Requirements for flame spread and smoke generation
- E. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500-hour salt spray test

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

- A. Loren Cook Company.
- B. Substitutions: Prior approval required

2.2 GENERAL

- A. The ERV unit shall be a factory assembled, one-piece unit. Contained within the unit enclosure shall be all factory wiring with a single point main power connection and 24-volt control wiring connections with quick connect plugs.

2.3 CONSTRUCTION

- A. The unit shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel, bolted to a minimum 16 gauge galvanized steel base with integral lifting lugs. Unit shall be provided with insulated top, side and interior panels utilizing 1" thick, three pound density foil faced insulation, manufactured and tested to meet NFPA 90A and UL 181 requirements. Insulation shall be fastened to the panels with weatherproof adhesive and weld pins. Energy recovery wheel shall be mounted in a slide track for easy inspection and cleaning. Separate blower and motor shall be provided for supply and exhaust airstream for independent system balancing. Blower and motor assemblies shall be mounted on rubber vibration isolators. Two inch thick, 30 percent efficient pleated filters shall be provided for supply and exhaust airstreams. Removable side panels shall be provided for easy access to motors, blowers, filters and energy recovery wheel. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.

2.3 ENERGY WHEEL

- A. Wheel shall be a total energy recovery wheel constructed of fluted synthetic fiber-based media impregnated with a non-migrating water selective 4 angstrom molecular sieve desiccant. Wheels with the desiccant applied in a secondary operation will not be accepted. Energy transfer ratings shall be ARI certified in accordance with the ARI Air-to Air Energy Recovery Ventilation Equipment Certification Program, based on ARI Standard 1060-2000.

2.4 FAN WHEEL

- A. Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

2.5 MOTORS

- A. Motor shall be Nema design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

2.6 COILS

- A. All heat and cooling coils shall be tested and rated in accordance with ARI Standard 410 and certified in accordance with the ARI Certification Program. DX coils shall be equipped with distributors to receive expansion valves at the liquid connections.

2.7 CONTROLS AND ELECTRICAL

- A. All internal electrical components shall be pre-wired for single point power connection. Internal control panel shall be UL listed with hinged access door and interlocking NEMA 3R disconnect switch. Each motor shall have a motor starter combination providing fuseless disconnect, over-current, overload and motor starting functions. A 24 volt circuit shall be provided to allow remote on/off control of ERV by building control system. Short circuit protection shall be provided on primary and secondary of control power transformer.

2.8 BEARINGS (SIZE 1500-8500)

- A. Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

2.9 BEARINGS (SIZE 10,000)

- A. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

2.10 BELTS AND DRIVES

- A. Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

END OF SECTION 227330

SECTION 227790 INDOOR WATER SOURCE HEAT PUMPS

PART 1 - GENERAL

- A. The HVAC system is based on the CGC Heat Pump System.
- B. The system will automatically provide the availability of heating or cooling functions 24 hours a day, 365 days a year without need for a changeover. The system is designed to function with 85°F supply hydronic fluid temperature at ambient conditions of 55°F and above. Below 55°F ambient the fluid loop temperature is elevated at a rate of approximately 1°F for each 2°F drop in ambient (i.e. the slope is equal to 0.5). The units shall be designed to provide heating without the use of the compressor. The fluid temperature rate of change (slope) will be adjusted during commissioning to best follow the building heating requirements.
- C. Flow Systems :The designer has selected the system to be a variable flow system; each unit shall be equipped with valve arrangement capable of shutting off fluid flow during periods of no call. Units shall also include an automatic flow limiting device to maintain the specified fluid flow during operating periods.
- D. Model selection and performance shall be in accordance with the schedule on the drawings.
- E. Each unit shall be pressure tested on both the refrigerant and fluid (water) circuits followed by a helium leak detection program for both circuits. Each unit shall be run tested for a minimum of 30 minutes and all control functions shall be checked out. Individual units shall be self contained and complete when shipped from the factory.
- F. Units shall be safety certified and bear a seal of approval from one of UL/ULC/ETL or ESA.
- G. Manufacturer shall warrant the parts only of each unit for a period of 12 months from the start-up date or 18 months from the unit shipment date whichever occurs first.
- H. Commissioning of the CGC unit(s) shall be performed by a CGC trained technician. A commissioning report shall be provided by the commissioning technician for review and approval by the owner's representative.
- I. Units shall be of the high efficient type and have minimum EER of 14.0 with only 2 GPM/ton and 86°F EWT
- J. System must be properly flushed and cleaned prior to commissioning.
- K. Alternate proposals shall include consideration for equipment space requirements, pipe and equipment sizing, electrical installation impact, operation costs, sound implications and redesign fees.
- L. Acceptable manufacturers:
 - a. Trane
 - b. Others with prior approval only..

PART 2 - MECHANICAL PARTS

2.1 HOUSING

- A. The housing of the unit shall be constructed based on a frame and panel principle with removable panels for maximum service access.
- B. The unit shall be fabricated with heavy gauge steel with all interior of cabinet lined with 1/2" acoustic insulation.
- C. The supply air opening shall be complete with discharge duct collar.
- D. The service panels shall be easily removable and sufficiently large to allow access to all components.

- E. The unit shall be provided complete with hanging brackets and rubber isolation.
- F. The cabinet shall be field convertible from straight through air supply discharge to end supply air discharge configuration.

2.2 BLOWER AND MOTOR

- A. The blower shall be statically and dynamically balanced.
- B. The complete blower section including motor shall be easily accessible and removable for service.
- C. The Blower motor shall be direct drive with integral thermal overload protection.
- D. The fan motor shall be ODP type.

2.3 FILTER

- A. The filter chamber shall be an integral part of the system located on return air path and should be serviceable from the front/rear of the unit.
- B. The filter shall be standard capacity, one [1 inch] thick "Disposable" type shipped with the unit.

2.4 HYDRONIC HEATING LOOP

- A. The refrigerant circuit shall not operate in the heating mode.
- B. Heating coil shall be aluminum fin and copper tube construction rated to withstand 300 PSI working pressure.

PART 3 - REFRIGERATION PARTS

PART 4 - REFRIGERATION SYSTEM

- A. The refrigeration circuit shall be available for operation on non-ozone depleting R410a refrigerant.
 - 1. The refrigeration circuit shall have the following components:
 - 2. Thermal Expansion Valve with external equalizer
 - 3. Filter dryer
 - 4. High pressure cut-out
 - 5. High pressure service port
 - 6. Low pressure cut-out
 - 7. Low pressure service port
- B. The service ports shall be located to facilitate field service with unit in place.
- C. All refrigerant piping shall be of type ACR copper pipe.
- D. The refrigerant circuit and components shall be factory assembled in a sealed, leak and performance tested, in a properly charged system.
- E. The sealed refrigerant circuit shall be certified for 600 PSIG working pressure.

CDMPRESSOR

- A. The compressor shall be high efficiency sealed hermetic rotary compressor on unit's size 018 and

below.

- B. The compressor shall be high efficiency sealed hermetic scroll compressor on unit's size 020 and above.
- C. The compressor shall be externally isolated on rubber mounts and connected to refrigerant circuit with floating piping to minimize sound transmission.
- D. The Compressor motor shall have integral thermal overload protection.
- E. The compressor shall not operate in the heating mode.
- F. The Compressor shall be provided with a 5 minute restart delay to avoid compressor short cycling and low pressure lockout.

DIRECT EXPANSION EVAPORATOR COIL

- A. The Refrigerant to air heat exchanger shall be aluminum fin and copper tube construction rated to withstand 300 PSI refrigerant working pressure.
- B. The coil shall have a maximum face velocity of 500 FPM
- C. A corrosion resistant condensate drain pan shall be provided under the coil.
- D. Condensate to drain out bottom of drain pan.

WATER COOLED CONDENSER MODULE

- A. The condenser shall be high efficiency refrigerant-to-water heat exchanger of copper inner water tube, minimum 1/2" diameter and steel refrigerant outer shell design, rated to withstand 600 PSI refrigerant working pressure and 300 PSI water pressure.
- B. The connections shall be female pipe thread mounted flush to the cabinet exterior.

END OF SECTION 227790

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SECTION 228150 - METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round spiral-seam ducts and formed fittings.
 - 3. Double-wall, round spiral-seam ducts and formed fittings.
 - 4. Duct liner.

1.3 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Provide commercial quality prime, bright spangled galvanized sheet steel, on all ductwork. Sheet metal shall be manufactured in the United States of America.
- B. Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

2.2 SEALANT MATERIALS

- A. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.4 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
- B. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.
- C. Provide turning vanes in all elbows over 20 degrees unless otherwise noted.
- D. Make ductwork transitions with sides sloped not to exceed a maximum of 20 degrees, 40 degrees included angle for diverging air flow and 30 degrees, 60 degrees included angle for converging air flow. Factory fabricated reducing fittings of ASME short flow nozzle design will be acceptable for round ductwork.
- E. 3.12 VAV primary supply air ductwork shall be joined with prefabricated galvanized "Ductmate" sections. The joint packing material and joint construction details using this method shall be submitted to the engineer for review

2.5 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1 " or 2" in height and width of ductwork to accommodate insulation thickness. Mount duct specialties such as turning vanes, damper, etc., to ductwork with the section insulated "Build Outs" to maintain continuity of thermal barrier.
- B. Adhere a single layer of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- D. Butt transverse joints without gaps and coat joint with adhesive.
- E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharges.
 - 2. Intervals of lined duct preceding unlined duct.

2.6 ROUND DUCT AND FITTING FABRICATION (Conceal Areas)

- A. Round, Longitudinal- and Spiral Lock-Seam Ducts (Concealed Low Pressure only): Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
- B. Duct Joints:
 - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
- C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," unless otherwise indicated.
 - 2. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 3. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - 4. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.
- F. Round Concealed VAV primary shall be single wall spiral lockseam. Fittings shall be "Ductmate"

2.7 DOUBLE-WALL DUCT AND FITTING FABRICATION (Exposed Structure Areas)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers: Lewis & Lambert, . or McGill Airflow.
- B. Ducts: Fabricate double-wall insulated ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
 - 1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
 - 2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
 - 3. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - 4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch- diameter perforations, with overall open area of 23 percent.
 - 5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Each duct system shall be constructed throughout for the specific pressure classifications shown on the contract documents in equipment or fan schedules listed as external or total static pressure.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," unless otherwise indicated.
- B. Construct and install ductwork to be completely free from vibration under all conditions of operation. Support and securely anchor ductwork and equipment from structural framing of building. Provide suitable intermediate metal framing where required between building structural framing.
- C. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, size, and shape and for connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- G. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 22 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Through-Penetration Firestop Systems."
- O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for duct pressure class indicated.
 - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 22 Section "Duct Accessories & HVAC Specialties."
- B. Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 228150

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SECTION 228200 - DUCT ACCESSORIES AND HVAC SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

- A. Specialties shall be factory fabricated items designed for low, medium or high velocity systems as indicated on contract documents. Submit shop drawings on all specialties required with shop drawings of ductwork layout. Specialties shall be as follows:
 - 1. Turning Vanes: Turning vanes shall be a true airfoil design; smoothly-rounded entry nose with extended trailing edge. Generated sound power level shall not exceed 54 decibels in band 4 at 2,000 FPM—duct size 24 x 24. Turning vanes shall be H•E•P—High Efficiency Profile—as manufactured by Aero/Dyne Co. or equivalent. Assemblies shall be fabricated with Aero/DyneCo. side rails; vanes installed on design centers across the full diagonal dimension of the elbow.
 - 2. Control Damper: (Round) Provide Ruskin model CDRS25. Equivalent by Carnes, CESCO, Greenheck, Nailor, Prefco, Titus, United McGill and, Louvers & Dampers Co.
 - 3. Volume Dampers: (Round - Velocities 1500 FPM and less) Provide Ruskin model MDRS25. Equivalent by Carnes, CESCO, Greenheck, Nailor, Prefco, Titus, United McGill and, Louvers & Dampers Co.
 - 4. Volume Dampers: (Rectangular - Velocities 1500 FPM and less) Provide Ruskin model MD35. Equivalent by Carnes, CESCO, Greenheck, Nailor, Prefco, Titus, United McGill and, Louvers & Dampers Co.
 - 5. Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4 inch wide heat and fire resistant neoprene coated glass fabric with two 3 inch wide 24 gauge metal strips attached to each edge. Duro-Dyne Corp. or equal. Provide stainless steel strips on acid exhaust fans.
 - 6. Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4 inch wide heat and fire resistant neoprene coated glass fabric with two 3 inch wide 24 gauge metal strips attached to each edge. Duro-Dyne Corp. or equal. Provide stainless steel strips on acid exhaust fans.
 - 7. Access Doors: Provide access doors in ductwork for access to fire dampers, smoke dampers etc., installed under this contract. Doors and frames shall be furnished in prime coat of gray rust inhibitive paint. Frames shall be seamless one-piece galvanized mild steel. The doors shall be outer and inner panels one-piece galvanized mild steel. The door insulation shall be a minimum of 1 " thick. Gasket shall be positive seal and fasteners progressive action cam locks type (zinc plated). Access doors shall be Nailor, Higgins, Milcor, CESCO or equal.
- B. Flexible duct shall be Flex master Type BM flexible duct in accordance with NFPA BOA, NFPA 90B and UL compliance, Class I Air Duct. Duct shall be factory insulated with flexible fiberglass insulation with a minimum R-value of 5.0 at a mean temperature of 75 F. The insulation shall be covered with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, procedure A. Flexible duct shall be rated for a velocity of at least 4000 feet per minute and suitable for operating temperatures of at least 250 F. Internal working pressure rating shall be at least 6 inches W.C. positive and 4 inches W.C. negative. Equivalent flexible duct by ATCO, Wiremold or approved equal. Maximum flexible duct length of run shall be 5'-0" unless shown otherwise. Contractor shall submit acoustic performance factors for flexible duct. Performance factors shall be equivalent to

the flexible duct specified. All flexible duct installed in attics shall be insulated with flexible fiberglass insulation with a minimum R-value of 8.0 at a mean temperature of 75 F.

9. Round take-off fittings from medium, high, and low pressure rectangular ductwork shall be made with Buckley BMD or equal bell mouth fittings. H.E.T. High Efficiency takeoffs, Buckley Model 33000 or equal will be allowed, where space is not available.
10. Fire Dampers: (Wall/Floor) Provide, at locations shown on plans, dynamic rated fire dampers constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1 1/2 hour fire protection rating, 212 F fusible link, and shall include a UL label in accordance with established UL labeling procedures. Damper Manufacturer's literature submitted for approval prior to installation shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes of dampers required at all anticipated air flow rates. Fire dampers shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing steel sleeves, angles, other materials, and practices required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Installation shall be in accordance with the damper manufacturer's instructions.
11. Counterbalanced Backdraft Dampers: Unless backdraft dampers have been specified with a piece of equipment, provide Ruskin model CBS7 counterbalanced backdraft dampers suitable for use in temperatures to 250 F and pressure differentials of 4" w.g. for 48" damper widths, 6" w.g. for 36" widths, 8" w.g. for 24" widths, and 10" w.g. for 12" widths. Damper frame shall be 8" x 2" x 14 gage steel channel, and blade shall be 16 gage galvanized steel. Axles shall be 1/2" diameter plated steel supported by ball bearings pressed into frame. Counterbalance weights shall be adjustable and mounted outboard of frame. Finish shall be mill galvanized.
12. Flexible Connections: Metaledge Ventglas prefabricated flexible connection of 3-1/4 inch wide heat and fire resistant neoprene coated glass fabric with two 3 inch wide 24 gauge metal strips attached to each edge. Duro-Dyne Corp. or equal. Provide stainless steel strips on acid exhaust fans.
13. Louvers: (Stationary) Provide louvers as indicated in the **LOUVER SCHEDULE** on the construction drawings. Louvers shall pass 1100 fpm free area velocity with less than 0.19" water pressure drop and shall carry less than 0.1 oz/sf of water during a 15 minute period when tested in accordance with AMCA Standard 500 Louvers shall bear the AMCA certified ratings. Equivalent by Cesco, Prefco, Pottorff, Greenheck, Louvers & Dampers, and Ruskin.

PART 3 - EXECUTION

A. SHEET METAL SPECIALTIES

1. Install sheet metal specialties in accordance with the manufacturer's requirements.

END OF SECTION 228200

SECTION 228350 - POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.
- B. All fans shall be AMCA certified for air and sound ratings.

PART 2 - PRODUCTS

2.1 EXHAUST FANS:

- A. Provide exhaust fans as indicated on drawings and schedule.
- B. Provide accessories as indicated on schedule.
- C. Equivalent by Carnes, Acme, Greenheck, Jenn Industries, Loren Cook, or Penn Ventilation.
- D. See **FAN SCHEDULE** on construction drawings.

PART 3 - EXECUTION

END OF SECTION 228350

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SECTION 228550 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

1.2 SUBMITTALS

- A. All grilles registers and diffusers shall be submitted with the following information for Engineers approval prior to installation:
 - 1. Airflow.
 - 2. Static Pressure Drop (maximum of 0.08" allowed).
 - 3. Noise Criteria Rating (maximum of 30 NC allowed).
 - 4. Throw - 150 FPM 100 FPM and 50 FPM.
- B. Any submittal found delinquent of requested information shall be returned for resubmittal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed as equivalents shall be subject to compliance with all requirements. Manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified. The specified or scheduled item shall represent the minimum level of quality.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

- A. Provide grilles, diffusers, and registers as shown on drawings and hereinafter specified. See drawings for size quantity.
- B. All dimensions indicated on drawings for diffuser neck sizes, face sizes, etc. are generic in nature and should be verified with equipment manufacturer prior to bid letting. Contractor shall be held responsible for compliance with specifications. Should a change be required to remain in compliance with specifications all costs incurred shall be paid by mechanical contractor.
- C. All registers and grilles shall have angled blades.
- D. Equivalent by Anemostat, Carnes, Krueger, Price, Nailor, Titus, and Tuttle & Bailey.
- E. Refer to **AIR DEVICE SCHEDULE** on construction drawings.

PART 3 - EXECUTION

3.1 DIFFUSERS, REGISTERS, AND GRILLES

- A. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable.

- B. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Support all grilles, registers and diffusers from tee bars or structure so as not to stress ceiling tile. Provide proper mounting supplied and arrangements for areas shown. Check architectural drawings for ceiling and wall construction.
- D. Set all units with rubber gaskets for air tight connection with mounting surface. Unless specified or noted otherwise grilles and registers mounted on ducts shall have standard margins.
- E. Install all return and exhaust grilles and registers with face of grille curve or angle toward line of sight to avoid seeing into space behind louver.
- F. Install all registers in masonry construction so that bottom of register starts with a masonry construction joint.
- G. Install diffusers, registers, and grilles level and plumb.
- H. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- I. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 228550

SECTION 229000 - BUILDING MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, service, material, tools and equipment necessary to furnish and install a complete and operating building management system as indicated on the drawings and/or specified herein. Major mechanical equipment, including water source heat pumps and energy recovery units shall be provided with factory-mounted unitary controllers. Unitary controllers shall interface with temperature controls via BACnet interface. Contractor and suppliers shall be responsible for verifying full and complete compatibility.

1.2 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2008, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A.
 - 7. EMC Directive 89/336/EEC (European CE Mark).
 - 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.3 QUALITY ASSURANCE

- A. The building management system shall be designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.

The contractor shall provide full-time, on-site, experienced project manager for this work, responsible for direct supervision of the design, installation, start-up and commissioning of the BAS system. The Bidder shall be regularly engaged in the design, installation and maintenance of BAS systems and shall have demonstrated technical expertise and experience in the design, installation and maintenance of BAS systems similar in size and complexity to this project. Bidders shall provide a list of at least 10 projects, similar in size and scope to this project completed within the past 3 years.

- B. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- C. All BAS peer-to-peer network controllers, central system controllers and local user displays shall

be UL Listed under Standard UL 916, category PAZX.

- D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- E. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 90 miles of project site.

1.4 SUBMITTALS

A. Drawings

- 1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
- 2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
- 3. Eight (8) complete sets (copies) of submittal drawings shall be provided.
- 4. Drawings shall be available in digital format.

B. System Documentation

- 1. Include the following in submittal package:
 - a) System configuration diagrams in simplified block format.
 - b) All input/output object listings and an alarm point summary listing.
 - c) Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - d) Complete bill of materials, valve schedule and damper schedule.
 - e) Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - f) Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
 - g) For all system elements—operator's workstation(s), building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
 - h) Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
 - i) A list of all functions available and a sample of function block programming that shall be part of delivered system.

C. Project Management

- 1. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents, and shall indicate timing and dates for system installation, debugging, and commissioning.

D. BACnet Device Object Naming Conventions

- 1. The BAS manufacturer's representative shall submit a BACnet Device Object Naming Convention Plan (DONCP) to the owner and consulting engineer during the submittal process. The plan must be approved by the owner and consulting engineer prior to implementation. It is the responsibility of the BAS contractor to coordinate the DONCP with the owner and consulting engineer.
- 2. The DONCP shall be designed to eliminate any confusion between individual points in a facility/campus wide EMCS system. It will also be designed to allow for future expansion and

consistency. Each device on a BACnet internetwork (including other manufacturer's devices) must have a unique device instance. This is a major consideration when adding to an existing system or interconnecting networks. Thorough and accessible site documentation is critical.

3. A consistent object (point) naming convention shall be used to facilitate familiarity and operational ease across an eventual large campus or inventory of facilities. The following section is designed as recommendations only. It is the responsibility of the BAS contractor to coordinate the DONCP with the owner and consulting engineer.
 - a) BACnet requires that all devices have a Device object name that is unique throughout the entire internetwork. To comply with this requirement all BACnet devices should be configured with a Device Object Name that is based on the naming conventions described in this section. This includes all physical devices as well as any logical BACnet devices that are represented by gateways. The vendor shall coordinate with the owner's staff to ensure that the correct names are used. Device Object Name properties shall support strings of at least 50 characters in length.
 - b) Every system device has addresses by which any other BACnet device can identify it and route information to and from it. Although there are a number of addresses to consider, the scheme is fairly straightforward. It can become complicated, however, if addresses have not been documented adequately or there is no logical addressing scheme.
 - c) When you set up and plan a BACnet network or add to an existing network, considering and documenting your addressing scheme is of the utmost importance. Adopt a hierarchical and uniform addressing scheme for device instances to help you quickly identify the function and location of different devices when troubleshooting. Additionally, it's very important to document every element of your addressing scheme and update the site documentation with any changes.
 - d) This section first covers the important addressing issues with respect to BACnet LANs and it gives a practical application you can use to check your understanding.
 - e) BACnet addressing
Three types of addresses are important in any BACnet system: network numbers, media access control (MAC) addresses, and device instances. Each BACnet device has these addresses associated with it. Though all three can be thought of as addresses, they are all very different both in how they function and how they are assigned.
 - f) **Network numbers** Identifies the network to which a BACnet device belongs. Every network on a BACnet LAN has a unique numerical identifier—a network number. This network number is used by BACnet devices only; it does not rely on nor does it affect any other network protocols. LANs connected by a router must have different network numbers. No interconnected BACnet networks can have the same network number. Network number range is 1–65,534, for a maximum of 65,534 interconnected BACnet networks.
 - g) **IMPORTANT:** BACnet reserves network numbers 0 and 65,535 for special purposes. Don't use network 0 or 65,535.
 - h) **MAC addresses:** Hardware-oriented. The MAC address uniquely identifies a device on its particular network. Each network type—Ethernet and MS/TP—has its own MAC addressing scheme. A device that exists on two or more networks will have a MAC address for each one. Devices can have the same MAC addresses as long as they are on networks with different network numbers.
 - i) **Note:** It's helpful to think of the MAC address as a house number and the network number as the street number. Two houses can have the same house number (MAC address) as long as they are on different streets (networks).
 - j) **Ethernet devices:** For Ethernet LANs, the IEEE assigns a certain range of MAC addresses to manufacturers of Ethernet products. The manufacturer then assigns a

unique MAC address to each of its Ethernet devices.

- k) **MS/TP devices:** For devices on an MS/TP LAN, you assign the MAC address for each controller. For BACtalk VLCs, these are assigned with DIP switches. Devices on an MS/TP LAN are designated as either masters or slaves, which affects how they can be addressed. This is a requirement of the BACnet specification. All BACtalk MS/TP devices are masters.
- l) **IMPORTANT:** BACnet reserves MS/TP MAC address 255 for special purposes. Don't use MS/TP MAC 255.
- m) **Device instances:** Software-oriented. The device instance identifies the device to the BACnet software and is the address most often encountered. The device instance is a shortcut to having to specify a MAC address and network number each time an operation is performed. Device instances range from 0-4194302.
- n) **Note:** BACnet reserves device instance 4194303 for special purposes. Don't use device instance 4194303.

1.5 WARRANTY

- A. Refer to 070000, General Conditions, Article 32 for additional warranty requirements.
- B. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one (1) year from completion of system acceptance.
- C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday, and 48 hours on Saturday and Sunday.
- D. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Approved building management system manufacturers shall be as follows:
 - 1. Automated Logic
 - 2. Trane
 - 3. Carrier

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this section may properly commence.
- B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections, installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum three (3) feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.4 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays
 - 1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization
 - 1. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trendlog
 - 1. All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm
 - 1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save
 - 1. Provide backup database for all standalone application controllers on disk.

3.5 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start up and commission systems. Allow sufficient time for startup and commissioning prior to placing control systems in permanent operation.
- C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for one (1) year or as specified.

- D. Provide owner's representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.6 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not be limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of three persons.
- C. Provide on-site training above as required, up to 16 hours as part of this contract.
- D. Provide tuition for at least one (1) individual to attend for a one-week factory training class. If applicable, costs for travel, lodging and meals will be the responsibility of the owner.

3.7 DEMONSTRATION

- A. Demonstrate complete operating system to owner's representative.
- B. Provide certificate stating that control system has been tested and adjusted for proper operation.

3.8 INTERLOCK DIAGRAM

- A. A detailed, point-to-point diagram of circuitry, including a typed sequence of operation and operation instructions, shall be submitted to the engineer by the Mechanical Contractor for review. As-built drawings shall be prepared after the engineer's final inspection to incorporate all changes made during installation. Provide copies for the engineer and owner's operating personnel.

3.9 CONTROL WIRING

- A. Provide control wiring and pilot circuit wiring to accomplish any control sequence or function shown on the drawings, mechanical systems, or equipment specifications.
- B. Control wiring means to furnish wire, conduit, fitting, miscellaneous materials and labor as required for mounting and connecting the electrical control devices furnished under this section of the specifications. All electrical work shall be done in accordance with the latest edition of the National Electric Code. All 120 volt control wiring shall be installed in metallic conduit. Low voltage control wiring does not require conduit, except as exposed in mechanical rooms. All thermostats, space sensors and wired remotes shall be mounted on an electrical junction box, with 1/2" conduit extended up thru the wall and stubbed into the ceiling or run to the controlled device. All wiring shall be concealed, except in equipment rooms, return air plenums, and mechanical or electrical closets. Conduit shall be fastened securely at regular intervals and shall be run parallel to the building lines.

3.10 ENERGY RECOVERY UNITS

- A. The Energy Recovery Units provide outside air to the spaces. When in the occupied mode the energy recovery units shall be enabled by the control system.

3.11 WATER SOURCE HEAT PUMPS

- A. Water source heat pumps shall be factory controlled units with factory furnished space sensors. When in the occupied mode the rooftop units shall be enabled by the control system.

3.12 DAMPERS

- A. The Mechanical Contractor shall furnish and install all automatic control dampers as indicated on the plans and required by the control sequences, unless dampers are specifically called out as an integral part of other equipment.
- B. Dampers shall be sized to meet flow requirements of the application. Damper blades shall be 16-gauge galvanized steel construction. Bearings shall be oilite or nylon with 1/2" shafts. Damper blade edges shall be fitted with tight sealing chlorinated polyvinyl chloride gasketing. Dampers shall have stainless steel jamb seals. Dampers shall be suitable for operation from -40 to 200°F.

3.13 CALIBRATION AND ADJUSTMENTS

- A. After completion of the installation, perform final calibration and adjustments of the controls provided under this contract. The HVAC Equipment Supplier's representative shall verify that all interfaces to the control panels are installed, functioning properly, and provide the sequences as specified. The Mechanical Contractor shall be responsible for all VRV control adjustments to provide proper system performance.

3.14 SYSTEM START-UP AND TRAINING

- A. The HVAC Equipment Supplier shall start-up/ commission the systems with on site factory certified personal. Certified personal shall have a minimum of (2) Years employment as technician. The HVAC Equipment Supplier shall provide three copies of an operator's manual describing all operating and routine maintenance service procedures to be used for controls provided. HVAC equipment supplier shall instruct the owner's designated representatives in operation and maintenance.

3.15 AUTOMATION SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2008, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc., and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. Operator's workstation software shall use Windows 7 Professional, Windows Server 2008 R2 or SQL Server 2008 R2 as the computer operating system. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software functions delivered on this project shall include password protection, scheduling (including optimum start), alarming, logging of historical data, full graphics including animation, after-hours billing program, demand limiting, and a full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited. All software required to program application specific controllers and all field level devices and controllers will be left with the owner. All software passwords required to program and make future changes to the system will also become the property of the owner. All software required to make any program changes anywhere in the system, along with scheduling and trending applications, will be left with the owner. All software passwords required to

program and make future changes to schedules, trends and related program changes will also become the property of the owner. All software required for all field engineering tools including graphical programming and applications will be left with the owner. All software passwords required to program and make future changes to field engineering tools, including graphical programming and applications will be left with the owner.

- C. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- D. Room sensors shall be provided with digital readout that allows the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow a technician to balance VAV zones and access any parameter in zone controller directly from the room sensor. Field service mode shall have the ability to be locked out.
- E. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller through BACnet LAN.
- F. All control equipment used to perform any or all of the specified smoke control sequences shall be UL-864 UUKL listed. This includes all field controllers and global control devices. Non-UUKL rated equipment shall not be networked to any devices on the network performing smoke control sequences unless isolated by a UUKL-rated device. See drawings for actual sequence of operations.

3.16 OPERATOR'S WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 simultaneous clients.
- B. BACnet Conformance
 - 1. Operator workstation shall be approved by the BTL as meeting the BACnet Advanced Workstation requirements.
 - 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 4. The operator's workstation shall comply with Annex J of the BACnet specification for IP connections. Must support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability

on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. Displays

1. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text such as Hand-Off-Auto. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three (3) graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse, for example, a graphic of a switch or light, which then displays a different graphic (such as an "ON" switch or lighted lamp. Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click an animated graphical object or switch it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.
4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned a minimum of five (5) graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the "increase" or "decrease" arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
5. Analog objects may also be assigned to a system graphic, where the color of the defined object changes based on the analog object's value. For example, graphical thermostat device served

by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.

6. A customized menu label (pushbutton) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label pushbuttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
7. The BAS displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a web browser resolving to a specified web address.
8. The BAS system shall have the ability to run multiple, concurrent displays windows showing continuously updated data.

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. Each operator's terminal shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to *discrete BACnet devices* to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal. Users should have the capability to be assigned to specific user type "groups" that can share the same access levels to speed setup. Users who are members of multiple "groups" shall have the ability to activate/deactivate membership to those groups while using the BAS (without logout). Users shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.
3. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
4. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. Operator Activity Log that tracks all operator changes and activities shall be included with system. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.
2. Log shall be gathered and archived to hard drive on operator's workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. Any displayed data that is changeable by the operator may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the

operator activity log using this method shall show all operator changes of just that displayed data.

F. Scheduling

1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

G. Alarm Indication and Handling.

1. Operator's workstation shall provide audible, visual, printed, and email means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s) currently running. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.
2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.
3. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).
4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
5. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or launch the Alarm Wizard to allow the creation of a new alarm.

H. Trendlog Information

1. System server shall periodically gather historically recorded data stored in the building

controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the operator's workstation. Operator shall be able to view all trended records, both stored and archived. All trendlog records shall be displayed in standard engineering units.

2. Software that is capable of graphing the trend logged object data shall be included. Software shall be capable of creating two-axis (X, Y) graphs that display up to 10 object types at the same time in different colors. Graphs shall show object values relative to time. Each trendlog shall support a custom scale setting for the graph view that is to be stored continuously. System shall be capable of trending on an interval determined by a polling rate, or change-of-value.
3. Operator shall be able to change trendlog setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.
4. System shall include a Trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.
5. System shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog view or launch the Trendlog wizard to allow the creation of a new trend.

I. Energy Log Information

1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

J. Demand Limiting

1. System shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a "first off-first on" mode, and in the other the loads are just shed/restored in

- a "first off-last on" (linear) fashion.
- 3. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.
- 4. Status of each and every load shed program shall be capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

K. Tenant Activity

- 1. System shall include program that monitors after-hours overrides by tenants, logs that data, and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a particular tenant. Every zone is monitored for after-hour override usage and that data logged in server. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.
- 2. Configuration shall include entry of the following information for use in logging and billing:
 - a. Tenant's contact name and address
 - b. One or multiple tenant zones that make up a total tenant space, including a separate billing rate for each separate zone
 - c. Minimum and maximum values an event duration and event limit
 - d. Property management information
 - e. Overall billing rate
 - f. Seasonal adjustments or surcharge to billing rate
 - g. Billing notification type such including, but not limited to, printer, file and email
 - h. Billing form template
- 3. Logging shall include recording the following information for each and every tenant event:
 - a. Zone description
 - b. Time the event begins
 - c. Total override time
 - d. Limits shall be applied to override time
- 4. A tenant bill shall be generated for a specific period using all the entered configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to view and be able to delete events from billing and edit a selected tenant activity event's override time.

L. Reports

- 1. System server shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs and override points. The frequency, content and delivery are to be user adjustable.
- 2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed or saved to a folder, either on the server hard drive or on any network drive location.

M. Configuration/Setup

- 1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

N. Field Engineering Tools

1. Operator's workstation software shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. System shall automatically notify the user when a device that is not in the database is added to the network.
7. System shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
- B. The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

O. Workstation Hardware

1. Provide operator's workstation(s) at location(s) noted on the plans.
2. Workstation/server computer minimum requirements
 - a) Enterprise Server (supports heavy trending and/or alarm handling at very large sites using SQL Server)
 - b) Windows 7 Professional, Windows Server 2008 R2, SQL Server 2008 R2
 - c) Visio 2010
 - d) Browser/client requirements: Internet Explorer v9.0 or later, Firefox v3.6 or later, Safari v2.0 or later (on Mac OS X). WEBtalk browsers: Internet Explorer 8.0, Firefox, Safari on Mac. WEBtalk mobile client support: Microsoft Mobile WAP browser, BlackBerry

P. Software

1. At the conclusion of project, contractor shall leave with owner a DVD ROM that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner how to completely restore the system in the case of a computer malfunction.

3.17 WEB INTERFACE

A. General

1. BAS supplier shall provide web-based access to the system as part of standard installation. User must be able to access all displays of real-time data that are part of the BAS using a standard web browser. Web browser shall tie into the network through owner-supplied Ethernet network connection. Webpage host shall be a separate device that resides on the BAS BACnet network, but is not the BAS server for the control system. BAS server must be a separate computer from the webpage host device to ensure data and system integrity. The webpage software shall not require a per-user licensing fee or annual fees. The webpage host must be able to support on average 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.

B. Browser Technology

1. Browser shall be Internet Explorer v9.0 or later, Firefox v3.6 or later, Safari v2.0 or later (on Mac OS X). WEBtalk browsers: Internet Explorer B.O, Firefox, Safari on Mac. WEBtalk mobile client support: Microsoft Mobile WAP browser, Blackberry. No special vendor-supplied software shall be needed on computers running browser. All displays shall be viewable and the webpage host shall directly access real-time data from the BAS BACnet network. Data shall be displayed in real-time and update automatically without user interaction. User shall be able to change data on displays if logged in with the appropriate user name and password.

C. Communications

1. Webpage host shall include two (2) Ethernet network connections. One (1) network connection shall be dedicated to BAS BACnet network and shall be used to gather real-time data from all the BACnet devices that form the BAS. This network shall communicate using BACnet, allowing the webpage host to gather data directly from units on the local LAN or from other projects connected over a WAN. This network shall also provide the connection to the BAS server for webpage generation.
2. The second Ethernet connection shall provide the physical connection to the Internet or an IP-based WAN. It shall be the port that is used for the browser to receive web pages and data from the webpage host. The webpage host shall act as a physical barrier between the BAS network and the WAN or Internet connection that allows the browser to receive webpages and data. The two separate network connections provide for a physical barrier to prevent raw BACnet traffic being exposed on the IP network.
3. The webpage host shall provide for complete isolation of the IP and BACnet networks by not routing networking packets between the two networks.
4. BAS BACnet Ethernet network shall be provided and installed by the BAS supplier. Owner shall provide and incur any monthly charges of WAN/Internet connection.

D. Display of Data

1. Webpage graphics shown on browser shall be replicas of the BAS displays. User shall need no additional training to understand information presented on webpages when compared to what is shown on BAS displays. Webpage displays shall include animation just as BAS displays. Fans shall turn, pilot lights shall blink, coils shall change colors, and so on.
2. Real-time data shall be shown on all browser webpages. This data must be directly gathered using the BACnet network and automatically updated on browser webpage displays without any user action. Data on the browser shall automatically refresh as changes are detected without re-drawing the complete display.

3. It shall be possible for user from browser webpage to change data if the user is logged on with the appropriate password. Clicking on a button or typing in a new value shall change digital data. Using pull-down menus or typing in a new value shall change analog data.
4. Data displays shall be navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.

E. Time Schedule Adjustment

1. Web access shall allow user to view and edit all schedules in the system. This includes standard, holiday and event schedules as described in BAS specification. Display of schedules shall show interaction of all schedules on a single display so user sees an overview of how all work together. User shall be able to edit schedules from this display.
2. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.
3. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.

F. Logging of Information

1. User shall use standard browser technology to view all trendlogs in system. User shall be able to view logged data in tabular form or graphical format. User shall be able to adjust time interval of logged data viewed and shall be able to adjust Y axis of data viewed in graphical format. User shall also be able to download data through the web interface to local computer. Data shall be in CSV format.

G. Alarm Handling

1. Web interface shall display alarms as they occur. User shall be able to acknowledge alarms using browser technology. In addition, user shall be able to view history of alarm occurrence over a user-selected time frame. In addition, those alarms may be filtered for viewing per user-selected options. A single selection shall display all alarms that have not been acknowledged.

H. Webpage Generation

1. Webpages shall be automatically generated from the BAS displays that reside on the BAS server. User shall access webpage host through the network and shall initiate a webpage generation utility that automatically takes the BAS displays and turns them into webpages. The webpages generated are automatically installed on the webpage host for access using any computer's standard browser. Any system that requires use of an HTML editor for generation of webpages shall not be considered.

I. Password Security and Activity Log

1. Access through web browser shall utilize the same hierarchical security scheme as BAS system. User shall be asked to log on once the browser makes connection to webpage host. Once the user logs in, any and all changes that are made shall be tracked by the BAS system. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and all activity of the users who have logged in to the system,

regardless of whether those changes were made using a browser or through the BAS workstation.

J. BACnet Communication

1. Web server shall directly communicate to all devices on the BAS network using BACnet protocol. No intermediate devices shall be necessary for BACnet communication.

3.18 BUILDING CONTROLLER

A. General Requirements

1. BACnet Conformance
 - a) Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b) Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet protocol standard.
3. Modules shall be selected to fit the particular project application. Up to seven (7) modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.
4. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.
8. Global control algorithms and automated control functions shall execute using 32-bit processor.
9. Schedules
 - a) Each building controller module shall support a minimum of 80 BACnet Schedule

Objects and 80 BACnet Calendar Objects.

- b) Building controller modules shall provide normal 7-day scheduling, holiday scheduling and event scheduling.
10. Logging Capabilities
- a) Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - b) Logs may be viewed both on-site or off-site using WAN or remote communication.
 - c) Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
 - d) Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
11. Alarm Generation
- a) Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b) Each alarm may be dialed out as noted elsewhere.
 - c) Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
 - d) Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.
12. Demand Limiting
- a) Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.
 - b) Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.
13. Tenant Activity Logging
- a) Tenant Activity logging shall be supported by building controller module. Each independent module shall support a minimum of 80 zones.
 - b) Tenant Activity logging shall function as defined in section 2.1.K of this specification.

B. Ethernet - MS/TP Module

- 1. Ethernet - MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
- 2. All communication with operator's workstation and all application controllers shall be through BACnet. Building controller Ethernet - MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP LAN. Ethernet - MS/TP module shall also route messages from all other building controller modules onto the BACnet Ethernet network.
 - a) MS/TP LAN must be software-configurable from 9.6 to 76.8Kbps.
 - b) The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).

3. BACnet Conformance
- a) Ethernet - MS/TP module shall, as a minimum, support MS/TP and Ethernet BACnet LAN types. It shall communicate directly using these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be approved by the BACnet Testing Laboratory (BTL) as meeting the BACnet Building Controller requirements.
 - b) All proprietary object types, if used in the system, shall be thoroughly documented and provided as
 - c) part of the submittal data. All necessary tools shall be supplied for working with proprietary
 - d) information.
 - e) The building controller shall comply with Annex J of the BACnet specification for IP connections. This
 - f) device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for
 - g) non-IP communications to other BACnet devices on the LAN. Must support interoperability on
 - h) WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).

C. MS/TP Module

- 1. MS/TP module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
- 2. Building controller MS/TP module communications shall be through BACnet MS/TP LAN to all advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN.
 - a) MS/TP LAN must be software configurable from 9.6 to 76.8Kbps
 - b) Configuration shall be through RS-232 connection.
- 3. BACnet Conformance
 - a) MS/TP module shall be approved by the BTL (BACnet Testing Laboratory) as meeting the BACnet Building Controller requirements. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly using this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types.
 - b) Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Power Supply Module

- 1. Power supply module shall power up to seven (7) building controller modules. Input for power shall accept between 17 - 30VAC, 47 - 65Hz.
- 2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for continuous operation of real-time clocks for minimum of 20 days.

E. Modem Module

- 1. Provide all functions that will allow remote communications using modem module to off-site

locations. Modem module shall integrate directly into modular controller without any special software or hardware. Include one (1) modem module along with all cabling necessary for installation for the system.

2. Provide off-site computer that allows operator to view and change all information associated with system on color graphic displays. Operator shall be able to change all parameters in this section from off-site location, including all programming of building controllers and all programmable application controllers including all terminal unit controllers.
3. Building controller shall have capability to automatically call out alarm conditions. If desired, controller may also send encoded message to digital pager. If an alphanumeric pager is in use by the operator, building controller shall be capable of sending a text or numeric string of alarm description. All building controllers connected to the local LAN shall be capable of calling out alarm messages through one or more shared modems connected to one or more of the building controllers on the local LAN.
4. Building controller shall have capability to call a minimum of 20 different phone numbers. Numbers called may be controlled by type of alarm or time schedule.
5. Owner shall provide standard voice-grade phone line for remote communication function.
6. Building controller and internal modem shall be capable of modem-to-modem baud rates of 33.6 Kbps minimum over standard voice-grade phone lines. Lower baud rates shall be selectable for areas where local phone company conditions require them.

3.19 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with LCD Readout

1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
2. The intelligent room sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in degrees Fahrenheit or Centigrade.
3. Override time may be set and viewed in half-hour increments. Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all air flow parameters shall be

viewed and set from the intelligent room sensor with no computer or other field service tool needed.

C. Wall Sensor

1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.

3.20 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read.

3.21 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.
- B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- D. Provide auxiliary pilot duty relays on motor starters as required for control function.
- E. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings; coordinate with electrical contractor.
- F. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit).

3.22 LOCAL SYSTEM CONTROLS

- A. The controls system shall include all necessary Daikin remote controllers and interface PCB's.
- B. One simplified Navigation controller (BRC1E71) shall be provided per room or fan coil as specified and be capable of controlling an individual fan coil or group of fan coils, up to 16 indoor units. Functions available to the occupants can be blocked.

- C. The controller shall have a liquid crystal display and provide the following facilities:
1. Temperature setting
 2. Fan speed setting
 3. Mode setting fan/cooling
 4. On/Off control
 5. Diagnostics Feedback (55 alarm codes)
- D. Remote air sensors KRCS01-1 shall be provided for local room sensing where fresh air is introduced to the fan coil unit. To be positioned within the room or close to the return air grill in the ceiling.

3.23 CENTRAL CONTROL SYSTEM

- A. The Graphical User Interface (GUI) shall employ browser-like functionality for ease of navigation. It shall include a tree view [similar to Windows Explorer] for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, end toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimal knowledge of the HVAC Control System and basic computing skills. The system shall be capable of controlling all units connected to the VRV/VRF system, including all indoor fan coil units, condensing units, energy recovery units, and mini/multi split systems.
- B. Local Workstation Features:
1. Minimum 10" LCD display with auto off after 30 minutes (default) is adjustable between 1 and 60 minutes, or the choice of different screen savers.
- C. Area and Group configuration:
1. Area contains one (1) or more Area(s) or Group(s)
 - a) A group may be a unit or point that has a network address
 - b) An Area is a tiered group where management points (units, digital input/output, and analog input groups) can be monitored and controlled by global settings. Up to 650 Areas can be created. Area hierarchy can have up to 10 tiered levels (ex. Top level: 1st floor west, 2nd level: offices, hallways, 3rd level: Office 101, 102, and 103, etc). Area configuration shall classify levels of monitoring and control for each management point.
 - c) Areas and Groups may be assigned names (ex. Office 101, North Hallway, etc.)
 2. Display settings
 - a) The Controller shall display On/Off, Operation Mode, Setpoint, Space Temperature, Louver Position, Fan Speed for each Area or Group.
 - b) System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Setback, Filter, Maintenance, and Screen Lock.
 - c) The controller shall display the temperature setpoint in one degree increments with a range of 60°F-90°F, 1°F basis (16°C-32°C, 0.1°C basis).
 - d) Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius
 - e) Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.
 - f) Graphic floor plan layouts
 - i. Display site floor plan as the background for visual navigation. Up to 4 status points can be assigned to the indoor unit icon (room name, room temperature, setpoint and mode).

3. Scheduling
 - a) The Controller shall display Date (mm/dd/yyyy, or yyyy/mm/dd, or dd/mm/yyyy format selectable) and day of the week along with the time of the day (12hr or 24hr display selectable).
 - b) The Controller shall adjust for daylight savings time (DST) automatically.
 - c) Weekly schedule settings 7 day weekly pattern
 - d) The schedule shall have the capabilities of being enabled or disabled, and should include minimum 100 independent schedules configurable with up to 20 events settable for each days schedule
 - i. Each scheduled event shall specify time and target Area or Group
 - ii. Each scheduled event shall include On/Off, Operation Mode, Occupied Setpoint, PreCool, Pre-Heat, Setback High, Setback Low, Remote Controller On/Off Prohibit, Remote Controller Mode Prohibit, Remote Controller Setpoint Prohibit, Fan Speed, and Setpoint Range Limit.
 - iii. A timer extension setting should be available to override zones into occupied mode and selectable from 30 to 180 minutes.
 - iv. Two tiers of setback temperatures should be available for both heating and cooling modes, dependent on occupancy schedule.
 - e) Up to 40 exception days can be scheduled yearly, and set on the set or floating date.
4. Errors
 - a) Error status shall be displayed in the event of system abnormality/error with one of three color coded icons placed over the indoor unit icon or lower task bar.
 - b) Limit errors are based upon preconfigured analog input upper and lower limit settings and are generated when the limits have been met. When limit error is generated a yellow triangle will be placed over the unit icon.
 - c) Communication errors shall be displayed with a blue triangle placed over the indoor unit icon.
 - d) Error history shall be available for viewing for up to 500,000 errors/abnormality events
5. Auto-Changeover
 - a) Auto-changeover shall be programmed to allow for the optimal room temperature to be maintained by automatically switching mode between Cool and Heat in accordance with the room temperature and setpoint.
 - i. The setpoint differential should be adjustable between 0°F to 13°F. The (Thermal) Differential is the tolerance of the indoor unit's setpoint.
 - ii. The operational mode shall change from cooling to heating when the room setpoint is exceeded by 1°F (adjustable).
 - iii. The operational mode shall be changed from heating to cooling when the room temperature drops 1°F (adjustable) below setpoint
 - iv. A guard timer (adjustable 15-60 minutes) should be in place to prevent rapid changing, but is overridden if the setpoint is changed.
6. Remote Access
 - a) Provide access to the Central Control System from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.
 - b) The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

- c) The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc. in order to allow the Web browser to function with the control system shall not be acceptable.
 - d) The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
7. External inputs (DIDO board)
- a) Digital input:
 - i. Standard 1 digital inputs and 3 pulse inputs, with an optional OI unit, 8 inputs can be added, multiple DI units can be connected depending on the available DI line.
 - b) Digital output
 - i. 4 contacts are available with the optional DIO unit. Standard 1 forced stop contact on controller.
8. Optional software
- a) Engineering of the software is required by Daikin on site
 - i. P.P.D: DCS002C51

3.24 HVAC CONTROL INTERFACE WIRING

- A. The wired remote (BRC) shall be installed by the Mechanical Contractor as shown on the plans. Each BRC shall be daisy chained to the indoor units. The indoor units are daisy chained to the BS boxes and Outdoor Units. Outdoor units are daisy chained and home run to the I-Touch controller. Additional wiring to the FA Unit will be provided so that the I-Touch can time schedule the unit through a DIDO board.
- B. The Mechanical Contractor shall be responsible for wiring the following but not limited to: indoor remote controllers, remote sensors, interface adaptors, daisy chaining indoor/outdoor units/fresh air units/bs boxes/ heaters/auto dampers that are shown on the Mechanical Contract Documents and
 - 1. Specifications. The Mechanical Contractor shall homerun to the Equipment Supplier's EMS control panels and make final tie-ins.
- C. The control system shall be connected by using non-polarity, 2-wire, non-shielded multiplex transmission system links from the single outdoor unit to multiple indoor units.
- D. The Mechanical Contractor shall be responsible for the commission of the controls system.

END OF SECTION 229000

SECTION 229300 - MECHANICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 COMMISSIONING AGENCY

- A. The commissioning agency (CA) has been contracted directly with the owner for this project. The CA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties to the design and construction process, including the mechanical contractor, and all specialty sub-contractors within the mechanical sections such as sheet metal, piping, refrigeration, water treatment, and controls, plus major equipment suppliers as required.

1.2 CONTRACTORS' RESPONSIBILITIES

- A. The mechanical division contractor's responsibilities are defined in Section 018100 of the specifications. These responsibilities apply to all specialty sub-contractors and major equipment suppliers within this division. Each contractor and supplier shall review Section 018100 and their bids shall include for carrying out the work described, as it applies to each Section within this division's specifications, individually and collectively.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 229300

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SECTION 229500 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division D1 Specification Sections, section 220100 - General Mechanical Requirements, section 220500 - Basic Mechanical Materials and Methods shall apply to this Section.

1.2 SUMMARY

- A. Air Systems:
 - 1. Constant-volume air systems.
 - 2. Variable-air-volume systems.
- B. Plumbing Piping Systems:
 - 1. Domestic hot water recirculation system systems.
- C. HVAC equipment quantitative-performance settings.
- D. Verifying that automatic control devices are functioning properly.
- E. Reporting results of activities and procedures specified in this Section.

1.3 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. The following balancing contractors will be accepted for this project. No other contractors shall be allowed unless approved by engineer.
 - 1. Systems Testing and Analysis.
 - 2. Total Air Balance.
 - 3. Testing & Balancing Company of the Dzarks.
- C. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- D. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's or NEBB forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems-Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- G. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- I. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Plumbing systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound IP units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR PLUMBING SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

- B. Prepare plumbing systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual and balancing valves for maximum flow.
 2. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 PROCEDURES FOR PLUMBING SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Measure flow at all manual balancing valves and adjust, where necessary, to obtain first balance.
- C. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- D. Adjust manual balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- E. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

3.9 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.10 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Electric-Heating Coils: Measure the following data for each coil:
 1. Nameplate data.

2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- B. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.
 5. Refrigerant suction pressure and temperature.

3.12 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.13 TOLERANCES

- A. Set HVAC & Plumbing system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.
 3. Plumbing-Water Flow Rate: 0 to minus 10 percent.

3.14 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.15 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report date, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams:
- F. Air-Handling Unit Test Reports:
- G. Apparatus-Coil Test Reports:
- H. Fan Test Reports:
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports:
- J. Air-Terminal-Device Reports:
- K. Compressor and Condenser Reports:
- L. Pump Test Reports:
- M. Air-to-Air Heat-Recovery Unit Reports:
- N. Instrument Calibration Reports:

END OF SECTION 229500

SECTION 260100 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections shall apply to this Section.

1.2 SPECIFICATION FORM AND DEFINITIONS

- A. These Specifications are abbreviated form and contain incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as noted on the drawings", "according to the drawings", "a", "an", "the" and "all" are intentional. Omitted words and phrases shall be supplied by inference.
- A. Refer to Section 007000, General Conditions, Article 1 for definitions that apply to these specifications.

1.3 GENERAL EXTENT OF WORK

- A. Provide electrical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of electrical systems. In no case will claims for "Extra Work" be allowed for work about which the Contractor could have informed himself before bids were taken.
- B. The Contractor shall familiarize himself with equipment provided by other Contractors which require electrical connections and controls.
- C. Make required electrical connections to equipment provided under Architectural and Mechanical divisions of this project, except where shown or specified otherwise. All temperature control electrical wiring and connections shall be by Electrical Contractor. Make required internal field wiring modifications indicated on wiring diagrams of factory installed control systems for control sequence specified. These field modifications shall be limited to jumper connections and connection of internal wiring to alternate terminal block lugs. Cost for field modifications requiring re-wiring of factory installed control systems for equipment provided by the Contractor or the Contractor shall be included in base bid of each respective contractor.
- D. Check electrical data and wiring diagrams received from the Contractor for compliance with project voltages, wiring, controls and protective devices shown on electrical drawings. Promptly bring discrepancies found to attention of Project Manager for a decision.
- E. Provide safety disconnect switches, contactors, and manual and magnetic motor starters for mechanical and electrical equipment requiring such devices. Omit these devices where included as part of factory installed prewired control systems provided with mechanical equipment. With exception of factory installed devices, provide safety disconnect switches, contactors and motor starters by one manufacturer to allow maximum interchangeability of repair parts and accessories for these devices.
- F. To maximum extent possible electrical controls in boiler rooms, equipment rooms, and control rooms shall be grouped in accessible locations and arranged according to function. Where possible use group control panels and combination starters in lieu of individually enclosed devices.

1.4 LOCAL CONDITIONS

- A. Visit site and determine existing local conditions affecting work in contract.
- B. Failure to determine site conditions or nature of existing or new construction will not be considered basis for granting additional compensation.

1.5 CODES, ORDINANCES, RULES AND REGULATIONS

- A. Provide work in accordance with applicable rules, codes, ordinances and regulations of Local, State, and Federal Governments, and other authorities having lawful jurisdiction.
- B. Conform to latest editions and supplements of following codes, standards or recommended practices.
 - 1. Safety Codes
 - a. National Electric Safety Code Handbook H30 - National Bureau of Standards.
 - b. Occupational Safety and Health Standards - Department of Labor.
 - c. Specifications for Making Buildings and Facilities Accessible To, and Usable By, the Physically Handicapped - American National Standards Institute ANSI A117.1.
 - 2. National Fire Codes:
 - a. NFPA No. 70 - National Electric Code, 2014 Edition.
 - b. NFPA No. 76A - Essential Electric Systems, 1973 Edition.
 - c. NFPA No. 101 - Life Safety Code, 1999 Edition.
 - 3. Underwriters Laboratories Inc.:
 - a. UL-508 - Standards for Industrial Control Equipment.
 - b. UL-1 008- Standard for Automatic Transfer Switches.

1.6 ALL MATERIALS, EQUIPMENT AND COMPONENT PARTS OF EQUIPMENT SHALL BEAR UL LABELS WHENEVER SUCH DEVICES ARE LISTED BY UL.

- A. Drawings and specifications indicate minimum construction standard, should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, the Contractor shall promptly notify Project Manager in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, he shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.
- B. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Project Manager with request for final inspection.

1.7 CONTRACT CHANGES

- A. Changes or deviations from contract, including those for extra or additional work must be submitted in writing for review of Project Manager. No verbal orders will be recognized.
- B. Changes in the work shall be submitted in accordance with AIA Document A201. General Conditions of the Contract for Construction.
- C. All change proposals shall be itemized indicating separately the costs for materials, labor, restocking charges, freight, bonds, insurance, overhead and profit. All materials shall be listed separately with quantities and individual unit prices. Labor factors shall be from a nationally recognized source with appropriate adjustments.

1.8 LOCATIONS AND INTERFERENCES

- A. Locations of equipment, conduit and other electrical work is indicated diagrammatically by electrical drawings. Layout work from dimensions on Architectural and Structural Drawings. Verify equipment size from manufacturers shop drawings.
- B. Study and become familiar with contract drawings of other trades and in particular general construction drawings and details to obtain necessary information for figuring installation. Cooperate with other workmen and install work to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed by Project Manager prior to installation.
- C. Any conduit, apparatus, appliance or other electrical item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed and if so shown relocated and reconnected without extra cost. Damage to other work caused by the Contractor, his Sub- Contractor, his workmen or by any cause whatsoever, shall be restored as specified for new work.

1.9 SYSTEMS PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliance operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.

1.10 WARRANTY

- A. Refer to 070000, General Conditions, Article 32 for additional warranty requirements.
- B. The Contractor warrants to Owner and Architect the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after date of substantial completion of building and acceptance of electrical systems by Owner.
- C. Where manufacturers' warranties expire during the one year warranty period, the Contractor shall include provisions for extending warranty for the full one year period and shall include cost for warranty extension in the Contractor's base bid. Where warranty extensions are not available from manufacturer, supplier or installer, the Contractor shall provide labor, parts and material warranty services equal to the requirements of these specifications and the terms of the manufacturer, supplier and installer warranties.
- D. the Contractor warrants to Owner and Architect that on receipt of written notice from either of them within one year warranty period following date of acceptance all defects that have appeared in materials and/or workmanship, shall be promptly corrected to condition required by contract documents at the Contractor's expense.
- E. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.
- F. Keep an itemized list of all equipment warranties listing equipment by name, mark, and type along with length and expiration date of each warranty. Submit two copies to Project Manager with request for final inspection.
- G. If the Architect's specification includes a warranty that exceeds the above warranty requirements the Architect's warranty shall take precedence.

1.11 MATERIALS EQUIPMENT AND SUBSTITUTIONS

- A. Reference Section 007000, General Conditions, Article 16 - SUBSTITUTIONS AND "OR APPROVED EQUAL"
- B. The intent of these specifications is to allow ample opportunity for the Contractor to use his ingenuity and abilities to perform the work to his and Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- C. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- D. In general these specifications identify required materials and equipment by naming first the manufacturer whose product was used as the basis for the project design and specifications. The manufacturer's product, series, model, catalog and/or identification numbers shall set quality and capacity requirements for comparing the equivalency of other manufacturer's products. Where other manufacturer's names are listed they are considered an approved manufacturer for the product specified, however; the listing of their names implies no prior approval of any product unless specific model or catalog numbers are listed in these specifications or in subsequent addenda. Where other than first named products are used for the Contractor base bid proposal it shall be his responsibility to determine prior to bid time that his proposed materials and equipment selections are products of approved manufacturers which meet or exceed the specifications and are acceptable to the Design Engineer.
- E. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Project Manager for review prior to procurement.
- F. Prior to receipt of bids, if the Contractor wishes to incorporate products other than those named in Specifications in his bid, he shall submit a written request for review of substitutions to the Design Engineer not less than seven working days prior to bid date. The Design Engineer will review requests and acceptable items will be listed in an addendum issued to principal bidders.
- G. Materials and equipment proposed for substitution shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Project Manager whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including the Manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- H. In proposing a substitution prior to or subsequent to receipt of bids, include in such proposal cost of altering other elements of Project, including adjustments in mechanical/electrical service requirements necessary to accommodate such substitution; whether such affected elements be under this contract or under separate contracts.
- I. Within 7 working days after bids are received, apparent low bidder shall submit to Project Manager for approval three copies of a list of all major items of equipment he intends to provide. As soon as practicable and within 30 working days after award of Contract, the Contractor shall submit shop drawings for equipment and materials to be incorporated in work for Project Manager's review. Where 30 working day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, the Contractor shall submit manufacturer's descriptive catalog data and

indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

- J. After execution of Contract, substitution of product brands for those named in Specifications will be considered, only if:
- K. Request is received within thirty days after Contract date and request includes statement showing credit due Owner, if any, if substitution product is used, or
- L. Owner requests consideration be given to substitute brands.

1.12 SHOP DRAWINGS, OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Reference Section 007000, General Conditions, Article 18 - Shop Drawings & Section 013300, Submittal Procedures
- B. The Contractor shall furnish a minimum eight sets of shop drawings of all materials and equipment. Project Manager will retain four sets.
- C. Where catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fittings, sizes, etc. that are to be provided. Mark each submitted item with applicable section and paragraph numbers of these specifications, or plan sheet number when item does not appear in specifications. Where equipment submitted does not appear in base specifications or specified equivalent, submittals shall be marked with applicable alternate numbers, change order number or letters of authorization. Each submittal shall contain at least two sets of original catalog cuts. Each catalog sheet shall bear the Manufacturer's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.
- D. The Contractor shall check all shop drawings to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Project Manager for their review. All shop drawings submitted to Project Manager shall bear the Contractor approval stamp which shall indicate that the Contractor has reviewed submittals and that they meet specification and/or drawing requirements. The Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All shop drawings not meeting the Contractor's approval shall be returned to his supplier for resubmittal.
- E. No shop drawing submittals will be considered for review by the Project Manager without the Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
- F. Project Manager will not be responsible for the cost of returning shop drawing submittals that are submitted to them without the Contractor's review and approval stamp. A letter will be sent to the Contractor by either the Architect or Engineer indicating receipt of an improper submittal, the Contractor shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. Project Manager will hold improper submittals for pick-up by the Contractor or supplier for 15 working days after date of receipt. If not picked up by the 16th working day, submittals will be disposed of by Project Manager.
- G. Project Manager's review of shop drawings will not relieve the Contractor of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing by Owner or his representative, nor shall it relieve the Contractor of responsibility for errors in shop drawings. No work shall be fabricated until the Project Manager's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be the Contractor's responsibility.

H. Operating and Maintenance Instructions:

1. Reference Section 007000, General Conditions, Article 32 & Section 013000, Submittal Procedures.
2. Submit with shop drawings of equipment, one set of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by the Manufacturer.
3. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.
4. Prepare complete brochure covering electrical systems and equipment provided under this contract. Submit brochures to Project Manager for review before delivery to Owner. The Contractor at his option may prepare brochure or retain an individual to prepare it for him. Include cost of this service in base bid. Brochures shall contain following:
 5. Certified equipment drawings and/or catalog data with equipment provided clearly marked as outlined under this specification.
 6. One copy each of balance and test reports required and as outlined under this specification.
 7. Complete operating and maintenance instructions for each item of equipment.
 8. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of electrical system.
9. Provide brochures bound in Wilson Jones No. B3-367-49R or National No. 82-87-684 3" capacity red vinyl guarded three ring binder with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on front cover label of each brochure the following:
 10. Project name and address.
 11. Section of work covered by brochure, i.e. "Electrical".

1.13 RECORD DOCUMENTS

- A. Reference Section 007000, General Conditions, Article 31.
- B. Record Drawings: Maintain a reproducible set of contract drawings and shop drawings in clean, undamaged condition, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding location on working drawings. Mark with red erasable red pencil and, where feasible, use other colors to distinguish between variations in separate categories of work. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work, which would be difficult to measure and record at a later date. Note related change-order numbers where applicable. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and prints suitable titles, dates and other identification on cover of each sheet.
- C. Record Specifications: Maintain one copy of specifications, including addenda, change orders, and similar modifications issued in printed form during construction, and mark-up variations (of substance) in actual work in comparison with text of specifications and modifications as issued. Give particular attention to substitutions, selection of option, and similar information on work where it is concealed or cannot otherwise be readily discerned at a later date by direct observation. Note related record drawing information and product data, where applicable. Upon completion of mark-up submit to Architect/Engineer for Owner's records.
- D. The contractor shall provide a full set of photographs showing the entire underground equipment. The photographs shall be taken prior to any concrete being poured. The underground equipment shall consist of, but not be limited to, the following:

Piping
Conduits
Ductwork

- E. The contractor shall provide the photographs in an 8.5" x 11" format for record keeping purposes with the maintenance manuals. The photos shall all be digital and a disk or C.D. shall be provided to the Owner as a permanent record.
- F. As-built documents shall be submitted for approval prior to final payment. Copies of "In-Progress" as-built drawings shall be submitted at each pay request.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

PART 4 - EXHIBITS (NOT USED)

END OF SECTION 260100

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SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and section 260100 - General Electrical Requirements shall apply to this Section.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 CIRCUITING

- A. Follow circuiting shown on drawings for lighting, power and equipment connections.

3.2 CUTTING AND PATCHING

- A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Cut no structural members without Architect's approval and in a manner approved by him.
- B. Patching shall be by mechanics of particular trade involved and shall meet approval of Architect.
- C. Drilling and cutting of openings through building materials require Architect's review and approval. Make openings in concrete with concrete hole saw or concrete drill. Do not use star drill or air hammer for this work.

3.3 SLEEVES

- A. Provide proper type and size sleeves for electrical ducts, busses, conduits, etc. passing through building construction. Where sleeves are installed by Others, supervise installation to insure proper sleeve location. Unless indicated or approved, install no sleeves in structural members. Sleeves shall be installed in concrete or masonry walls or floors and where otherwise noted.
- B. Each sleeve shall be continuous through wall floor or roof and shall be cut-flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved. Sleeves shall be required through floors subject to flooding such as toilet rooms, equipment rooms and kitchens. The contractor shall have the option of:
- C. Providing a cast iron sleeve with integral flanges extending 1 inch above finished floor. Sleeve shall be cast in concrete when floor is poured. Annular space between sleeve and pipe shall be filled with Kawool.

or
- D. Provide core-drilled opening in concrete with Thunderline Unk-Seal or Calpico Sealing Linx between piping and opening.
- E. Sleeves passing through floors and exterior walls with waterproof membranes shall be core-drilled (floors only) and sealed with Thunderline Link-Seal or Calpico Sealing Linx.
- F. Where electrical ducts, busses, conduits, wiring, etc. passed through fire walls, floors, and smoke partitions seal annular space between sleeve and item passing thru with Kaowool Fire Master Bulk Packing. Packing thickness shall be sized per manufacturer's recommendation for maintaining the

integrity of the fire wall/floor or smoke partition. Fire protection system shall be rated per ASTM E 119. Equivalents to Kaowool are 3M, Flame Stop, or Flame Safe.

- G. Where piping passes through walls serving as supply or exhaust air plenums or chases, seal annular space between pipe and sleeve air tight with Thunderline Link-Seal or Calpico Sealing Linx.

3.4 MUTILATION

- A. Mutilation of building finishes, caused by installation of electrical equipment, fixtures, outlets and other electrical devices shall be repaired at the Contractor's expense to approval of Architect.

3.5 EXCAVATION AND BACKFILL

- A. Perform necessary excavating to receive work, provide necessary sheathing, shoring, cribbing, tarpaulins, etc. as required and remove same at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation of work.
- C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footings with selected earth or sand and tamp to compaction required by PM. Mechanically tamp backfill under concrete and pavings in 6 inch layers to 95% standard density.
- D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
- E. When available refer to test hole information on Architectural drawings or specifications for types of soil to be encountered in excavations. Where rock is indicated, list unit cost for rock excavation in base bid.

3.6 SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown or specified. Level, shim, and grout equipment bases as recommended by the Manufacturer. Mount motors, align and adjust drive shafts and belts according to the Manufacturer's instructions. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by the Contractor at no cost to Owner.
- B. Provide concrete bases for all floor and slab mounted equipment. Refer to drawings for required base type and size. Provide 3 1/2" high base where base is not shown on drawings.
- C. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. The Contractor shall arrange for attachment to building structure, unless otherwise indicated on drawings or specified. Provide hangers with vibration eliminators where required. Contractor shall verify that structural members of building are adequate to support equipment. Submit details of hangers, platforms and supports together with total weights of mounted equipment to PM for review before proceeding with fabrication or installation.

3.7 PAINTING OF MATERIALS AND EQUIPMENT

- A. Equipment and materials exposed to interior dry environment shall have a minimum of one primer and one finish coat. Equipment and materials mounted in exterior location shall have a minimum of one primer and two coat colors in finish areas shall be selected by PM.

- B. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- C. Where extensive refinishing of factory applied finishes are required equipment shall be completely repainted. PM will make final determination on extent of refinishing required.

3.8 MAINTENANCE OF SYSTEMS

- A. The Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under his contract through substantial completion.

3.9 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT

- A. It shall be the Contractor's responsibility to protect and prevent damage to all electrical materials and equipment stored and/or installed under this contract. All work, materials and equipment shall be adequately protected by any and all means necessary to prevent damage by weather, flooding, condensation, construction debris, fire, and construction equipment and vehicles.
- B. Where job conditions, or work of other contractors produce the potential for damage to electrical systems and equipment, the Contractor shall immediately notify the the Contractor so that corrective action can be taken.
- C. The Contractor shall take extra precautions to protect electrical equipment containing solid state electronics, open relays, and contacts from damage by water, dust, dirt, construction debris and the formation of condensate. All equipment so damaged shall be replaced by the Contractor with new equipment at no cost to Owner.
- D. The Contractor shall periodically inspect and clean all systems and equipment to insure all systems and equipment remain in like new condition during construction. All cleaning shall be done in accordance with the Manufacturer's recommendation where available and applicable.
- E. Before request for final inspection all systems and equipment shall be properly cleaned, vacuumed, polished, painted, etc. as required to return equipment to like new appearance.
- F. All equipment requiring painting or touch-up shall be properly prepared and painted in accordance with this specification.
- G. The Contractor shall keep a written record listing systems and equipment cleaned. Where special procedures or chemicals were used or where partial or complete disassembly of factory assembled equipment was necessary, the Contractor shall list special procedures and/or disassembly required and equipment components affected. Prior to final inspection the Contractor shall submit two copies of cleaning record to PM for their records.

3.10 START-UP, CHANGE-OVER, TRAINING AND OPERATING CHECK

- A. The Contractor shall perform initial start-up of systems and equipment. Personnel qualified to start-up and service this equipment, including manufacturers technicians, when specified, and Owner's operating personnel shall be present during these operations.
- B. The Contractor shall be responsible for training Owner's operating personnel to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructor's name, names of Owner's personnel attending and total hours of instruction given each individual.
- C. The Contractor shall report in person to Owner's operating Engineer at end of first month of operation and thereafter at end of first month of operation and thereafter at end of sixth and twelfth months after date of substantial completion of building to check operation of equipment that was installed under contract. Contractor shall answer operating personnel's questions regarding system operation and shall ascertain that systems are operating normally and are being properly maintained by Owner. If the Contractor finds that systems are not being operated and maintained as designed, he shall inform the Building Engineer/Owner and PM in writing.

- D. After each inspection, the Contractor shall submit written report to PM indicating condition of equipment and including any recommended changes in operation of system or other information which will be helpful to Owner.

3.11 PRE-FINAL AND FINAL CONSTRUCTION REVIEW

- A. At the Contractor's request, PM will make pre-final construction review to determine if to the best of their knowledge project is completed in accordance with plans and specifications. Items found by PM as not complete or not in accordance with requirements of contract will be outlined in report to the Contractor. After completion and/or correction of these items, the Contractor shall notify Architect he is ready for final review.
- B. At same time of final construction review, the Contractor and his major sub-contractors shall be present or be represented by a person of authority. Each Contractor shall demonstrate, as directed by PM, that his work complies with purpose and intent of plans and specifications. Each Contractor shall provide labor, services, instruments, and tools necessary for such demonstrations and tests.

3.12 RECORDING AND REPORTING TESTS AND DATA

- A. Record nameplate horsepower, amperes, volts, phase service factor and other necessary data on motors and other electrical equipment furnished and/or connected under this contract.
- B. Record motor starter catalog number, size and rating and/or catalog number of thermal-overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specification for instructions for proper sizing of thermal-overload units.
- C. Record amperes-per-phase at normal or near-normal loading of each item of equipment furnished and/or connected.
- D. Record correct readings of each feeder conductor after energized and normally loaded, and again after balancing of feeder loads as required by current readings.
- E. Record voltage and amperes-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load. This reading shall be taken continuously for a 24 hour period and recorded on permanent tape and submitted to PM.
- F. Record voltage and amperes at transformer secondary and primary stations, at normal loading. Record transformer percentage "taps" finally selected. Transformers shall be connected to produce voltage at building service entrance equipment as follows:

Nominal System Voltage	Service Entrance Voltage
200	208
- G. Submit at least two (2) copies of data noted above to PM for review prior to final inspection.
- H. Keep a record of all deviations made from routes, locations, circuiting, etc. shown on contract drawings. Prior to final inspection submit one new set of project drawings with all deviations and changes clearly indicated.

END OF SECTION 260500

SECTION 260600 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

- A. Supplement grounded neutral of secondary distribution system with equipment grounding system, installed so that metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items operate continuously at ground potential and provide low impedance path for ground fault currents. System shall comply with National Electrical Code, modified as indicated on drawings as specified.
- B. Provide equipment ground bus in base of low voltage switchgear or switchboard. Braze or otherwise adequately connect ground system to at least three 3/4" diameter by 10'-0" long ground rods. Where extra rods are necessary to meet requirements of specified tests, the Contractor shall be reimbursed for additional cost. Rods shall be located a minimum of six feet from each other of any other electrode and shall be interconnected by a minimum 3/0 bare copper conductor brazed to each ground rod below grade.
- C. Ground metallic water piping system to electrical service ground with a minimum 3/0 or as required green insulated copper ground conductor, in conduit. Where a dielectric main water fitting is installed, connect ground conductor to building side of dielectric water fittings. Do not install jumper around dielectric water fitting. Bond conduit to ground conductor at each end. Provide 3/0 jumper with ground clamps around water meter.
- D. Provide grounding electrode system as required by the Latest National Electrical Code, Section 250-81 -H.
- E. Connect system neutral ground and equipment ground system to common ground bus.
- F. Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with National Electric Code. Provide each service disconnect enclosure with neutral disconnecting means which interconnect with insulated neutral and uninsulated equipment ground sub to establish system common ground point. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.
- G. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Table 250-95. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with approved pressure connectors. Provide feeder servicing several panelboards with a continuous grounding conductor connected to each related panelboard ground bus.
- H. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder, and each branch circuit except as specified herein. Where more than one branch circuit is installed in a common raceway only one grounding conductor is required. Grounding conductor shall be sized for largest branch circuit overcurrent device serving common raceway.
- I. Single phase 120 volt branch circuits for lighting shall consist of phase and neutral conductors installed in common metallic conduit which shall serve as grounding conductor. Provide flexible metallic conduit utilized in conjunction with above single phase branch circuits with suitable green insulated

grounding conductors. Feeders and branch circuits in non-metallic conduits shall be provided with separate grounding conductor. Install grounding conductor in common conduit with related phase and/or neutral conductors. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.

- J. The Contractor shall provide equipment grounding bars for termination of equipment grounding conductors in panelboards and other electrical equipment. In addition to active circuits, provide pressure connectors for panel spares and blank spaces.
- K. Provide electrical expansion fitting with an external flexible copper ground securely bonded by approved grounding straps on each end of fitting except where UL approved built-in copper grounding device is provided.
- L. Provide non-metallic conduits or ducts with equipment grounding conductors except for conditions as follows:
 - 1. Where ducts are for telephone or communication uses only.
- M. Connect each cable rack system to equipment grounding system with insulated conductor with size determined by largest power conductor in rack. Minimum size shall be No. 6 and maximum size shall not exceed equivalent capacity of number 4/0 copper conductor. Ground conductor shall be bonded to rack system, enclosed in conduit, and connected to common ground bus.
- N. Provide electric devices such as air cleaners or heaters control switch, etc., installed in air ducts, with insulated equipment ground conductor sized on rating of overcurrent device supplying unit. Bond conductor to each unit, air duct, and to ground in panelboard.
- O. Provide electric immersion type water heater or surface heating cables with insulated equipment ground conductor sized on rating of overall device supplying unit. Bond conductor to water piping at unit and to ground bar in panelboard.
- P. Provide steel and aluminum conduits which terminate without mechanical connection to metallic housing of electrical equipment with ground bushing and connect each bushing with bare copper conductor to ground bus in electrical equipment. Electrically non-continuous metallic conduits containing ground wiring only shall be bonded to ground wire at both conduit entrance and exit.
- Q. Ground and bond exterior mounted light poles, radio and television masts and flag poles with No. 6 or larger bare copper wire connected to 96" long, 3/4" copper clad ground rod driven in ground.
- R. Test complete equipment grounding system to each service disconnect enclosure ground bar with Vibroground test unit manufactured by Associated Research Inc. Resistance, without chemical treatment or other artificial means shall not exceed five (5) ohms to ground. Submit certified test reports of compliance with five (5) ohm value.

END OF SECTION 260600

SECTION 260720 - ELECTRICAL SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 26010 0- General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 INDIVIDUAL CONDUITS SUSPENDED FROM CEILING SHALL BE SUPPORTED BY STEEL CITY NO. C-1 49 HANGERS.

- A. Provide inserts, hangers and accessories with finish as follows:
- B. Galvanized: Concrete inserts and pipe straps.
- C. Galvanized or Cadmium Plated: Steel bolts, nuts, washers, and screws.
- D. Painted with Prime Coat: Individual hangers, trapeze hangers and rods.
- E. Equivalent hanger and support systems by Binkley, Fee and Mason, Kin-Line or Unistrut.
- F. Inserts shall be Grinnel Figure 279, 281, 282, or 285 or equivalent as required by load and concrete thickness.
- G. Provide beam clamps suitable for structural members and conditions.
- H. Provide 3/8" minimum diameter steel hanger rods galvanized or cadmium-plated finish.
- I. Trapeze hangers shall be Kindorf Series 90 channel with fittings and accessories as required.
- J. Attach each conduit to trapeze hanger with Steel City No. C-1 05 clamps for rigid conduit and Steel City No. C-1 06 clamps for electrical metallic tubing (EMT).

PART 3 - EXECUTION

3.1 ELECTRICAL SUPPORTS:

- A. Support vertical and horizontal conduit runs at intervals not greater than 10 feet, within 3 feet of any bend and at every outlet or junction box. Where plastic conduit is used follow the Manufacturer's recommended hanger spacing.
- B. Install multiple runs of conduits as follows:
- C. Where a number of conduits are to be run exposed and parallel, group and support with trapeze hangers.
- D. Fasten hanger rods to structural steel members with suitable beam clamps and to concrete structures with inserts set flush with surface. Install concrete inserts with reinforced rod through opening provided in inserts.
- E. Install clamps for single conduit runs as follows:
- F. Support individual runs by approved pipe straps, secured by toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine

screws or bolts on metal surfaces; and wood screws on wood construction. Use of perforated strap not permitted.

- G. Install exposed conduits in damp locations with clamp backs under each conduit clamp to prevent accumulation of moisture around conduits.

END OF SECTION 260720

SECTION 260750 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION:

- A. Provide identification and warning signs to wiring and equipment as listed in schedule. Signs and tags shall be as follows:
 - TYPE 1: Laminated phenolic plastic with black Gothic-condensed lettering by Seaton or Wilco.
 - TYPE 2: Self-sticking 1/2" wide plastic tape with high gloss surface and embossed lettering by Brady or Oymo.
 - TYPE 3: Self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1 - 1964 and OSHA 19.O.144iii(2) Specifications, by Brady or as approved.
 - TYPE 4: Self-sticking flexible vinyl with oil resistant adhesive for -20 degrees to 300 degrees F. temperatures by Brady or as approved.
- B. Provide switchboards with Type 1 signs 2-1/2" x 12" indicating switchboards designation and electrical characteristics as noted on drawings. Provide switchboards sections operating at different voltages with Type 1 sign 2" x 8" indicating electrical characteristics of section. Provide each switchboard device with Type 1 sign 1-1/4" x 5" indicating load served.
- C. Provide distribution panelboards with Type 1 signs 2" x 8" indicating panel designation and electrical characteristics. Provide branch devices with Type 1 sign 1" x 4" indicating load served.
- D. Provide lighting and power panelboards with Type 1 sign 1-1/4" x 6" indicating panel designation, electrical characteristics, and source of power. Source of power indication shall indicate source panel designation and switch or breaker number. Mount inside of panel door on circuit breaker trim flange just below breakers.
- E. Provide disconnect switches, time switches, lighting contactors, motor starters and controllers with Type 1 sign 1-1/4" x 6" indicating equipment served, electrical characteristics, and source of power.
- F. Provide electrical equipment and accessible wiring enclosures operating at voltage above 240 volts with Type 3 Brady No. AE-461 25 warning sign and Brady Style B, 1-1/8" x 4-1/2" voltage marker applied to front door or cover of device or enclosure. Provide large equipment such as transformers and main distribution equipment with Type 3 sign Brady No. AE-46639.
- G. Provide feeders and branch circuit home runs with Type 4 wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
- H. Provide Type 2 tape at feeder terminal lugs to switchboards and panelboards. Tape shall indicate conduit size, conductor type and AWG size. Tape shall be located to be easily read with conductors installed.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 260750

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SECTION 261200 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 26050 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Unless noted otherwise conductors referred to are wires and cable. Provide code grade soft annealed copper conductors with specified insulation type in proper colors to conform with color coding specified. Provide conductors No. 8 gauge and larger stranded and conductors No. 10 gauge and smaller may be solid or stranded.
- B. Use no conductors smaller than No. 12 gauge unless specifically called for or approved by the Design Engineer. Size wire for 120 volt branch Circuits for 3% maximum voltage drop. Size feeder circuits for 2% maximum voltage drop. Combined voltage drop of feeders and branch circuits shall not exceed 5% maximum.
- C. Provide conductors for listed applications as follows:
 - 1. Lighting and Receptacle Circuits: Type THHN, 600 volt, 90 degree C (194 degrees F) thermoplastic insulated building conductor.
 - 2. Power Circuits and Feeders: Type THHN, 600 volt, 90 degree C (194 degrees F) thermoplastic insulated building conductor.
 - 3. Low Voltage and Line Voltage Conductors Sizes No. 16 and No. 18 AWG: Type TFFN, 600 volt 90 degrees C (194 degrees F) thermoplastic insulated building conductor.
 - 4. Underground Power Circuits and Feeders: Type THHN / TWHN, 600 volt, 75 degree C (167 degrees F) wet rating and 90 degree C (194 degrees F) dry rated thermosetting filled insulating cable.
- D. Provide conductors by Anaconda, General Cable, General Electric, Phelps Dodge, or equivalent.

2.2 CONDUCTOR COLOR CODING

- A. Provide continuous color coding for feeder, branch and control circuits. Insulation or identification tape color shall be same color for like circuits throughout. Where specified insulation colors are not available in larger wire sizes color code conductor at all accessible locations with Scotch 35 allweather color code tape.
- B. Identify the same phase conductor with same color throughout.
- C. Provide conductors with color coding indicated. Where more than one standard voltage system is installed provide same colored conductors with indicated tape or stripe to indicate system voltage.

SYSTEM VOLTAGE	CIRCUIT	COLOR	INSULATION COLOR	STRIPE
120/208	Neutral		White	-

120/208	Phase A	Black	-	
120/208	Phase B	Blue	-	
120/208	Phase C	Red	-	
120/208	Switch	Same as Phs. Color		White
120/208	3-Way Sw Runner	Purple	-	
120/208	Control	Pink	-	
120/208	Equip. Ground	Green	-	

PART 3 - EXECUTION

3.1 CONDUCTOR INSTALLATION

- A. Run conductors in conduit continuous between outlets and junction boxes with no splices or taps pulled into conduits.
- B. Neatly route, tie and support conductors terminating at switchboards, motor control centers, panelboards, sound equipment, etc. with Thomas & Betts Ty-Rap cable ties and clamps or equivalent by Electrovert or Panduit.
- C. Make circuit conductor splices with Buchanan B-Cap nylon insulated connectors or equivalent by Ideal or 3M.
- D. Make fixture and device taps with Scotchlock self-stripping electrical tap connectors.
- E. Terminate solid conductors at equipment terminal strips and other similar terminal point with insulated solderless terminal connectors. Terminate all stranded conductor terminal points with insulated solderless terminal connectors. Provide Thomas & Betts Sta-Kon insulated terminals and connectors or equivalent by API/AMP Blackburn, Buchanan or Scotchlock.
- F. Where a total of six or more control and feeder conductors terminates in a multiple device panel or enclosure that has no built-in terminal blocks provide mounting channel and see-thru covers. Equivalent terminal blocks by General Electric, Square "D" or Westinghouse.
- G. Wrap conductor taps and connections requiring additional insulation with a minimum of three overlapped layers of 3 M Scotch vinyl plastic electrical tape No. 88 or equivalent,

END OF SECTION 261200

SECTION 261300 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 STEEL CONDUIT

- A. Rigid Conduit: Provide steel conduit meeting current ANSI Standard Specification C80.1 with hot-dipped galvanized and clear lacquer finish.
- B. Electrical Metallic Tubing (EMT): Provide thinwall conduit meeting current ANSI Standard Specification C80.3 with electro-galvanized and clear lacquer finish.
- C. Rigid Conduit and EMT Fittings: Provide Appleton Form 35 non-thread malleable iron unilets. Equivalent by CrouseHinds or Pyle National.
- D. Rigid Conduit Connectors and Couplings: Provide Appleton steel NO-THREAD TYPE, rain and concrete tight. Equivalent by Thomas and Betts or Steel City.
- E. EMT Connectors and Couplings: Provide Appleton steel COMPRESSION THINWALL TYPE, rain and concrete tight. Equivalent by Thomas and Betts or Steel City.
- F. Liquid-Tight Flexible Conduit Fittings: Appleton "STB" series insulated connectors. Equivalent by Pyle-National or Thomas and Betts.
- G. Provide insulated throat fittings when type THHN/THWN conductors are installed.
- H. All wiring shall be in steel conduit unless otherwise noted.
- I. Short runs of flexible galvanized steel conduit may be used where permitted by code. Lengths greater than 6 feet require review by Engineer.
- J. Make conduit connections to motors and equipment mounted on resilient mounts or vibration isolators with Type U.A. liquid-tight flexible conduit manufactured by Anaconda, or "Liquatite" by Electric-Flex Company.
- K. Where conduits cross building expansion joints provide O-Z expansion fitting type "AX", "TE", "EX" or "EXE" as required.
- L. Provide low voltage control systems and sound systems in conduit unless noted otherwise.
- M. Set screw type conduit fittings will not be allowed.
- N. MC cable will be allowed for the office areas in Project 3 only. EMT conduit shall be used for all homeruns from panel to transition junction box near load served.

2.2 PLASTIC CONDUIT

- A. Normal duty applications in concrete slabs or underground without concrete encasement. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.

- B. Normal duty exterior underground application direct burial: Provide semi-rigid polyvinyl chloride (PVC) type DB plastic duct meeting current NEMA Standard TC-6 and Western Underground Committee Specifications.
- C. Normal exterior underground application encased burial: Provide semi-rigid polyvinyl chloride (PVC) type A plastic conduit meeting current NEMA and Western Underground Committee Specifications.
- D. Provide matching plastic conduit fittings by the Manufacturer. Fittings shall meet the same Standards and specifications as the conduit on which it is installed.
- E. Joining and bending of conduit and installation of fittings shall be done only by methods recommended by the Manufacturer.
- F. Provide conduit support spacing as recommended by the Manufacturer for the highest ambient temperature expected,
- G. Provide interlocking conduit spacers by the Manufacturer or multiple runs of underground conduits installed in same trench.
- H. Ends of feeder conduit terminating at transformers, switchgear, manholes, etc. shall be terminated with bell ends to protect conductor insulation.
- I. Install no plastic conduit in areas where ambient temperature may exceed 150 degrees under normal conditions nor on heat producing equipment such as boilers, incinerators, etc. Install no plastic conduit in a return air or supply air plenum for the HVAC systems.
- J. Provide expansion couplings on conduits located in areas where ambient temperatures are constantly changing and on long runs regardless of ambient temperatures. Determine amount of conduit expansion and contraction from the Manufacturer's published charts or tables.
- K. Plastic conduit and fittings shall be by Carlon Products Division of Continental Oil Company.
- L. Plastic conduit shall not be used above grade for any purpose. All transitions from PVC to steel shall be made below grade.

2.3 BUSHINGS AND LOCKNUTS

- A. Enter outlet boxes squarely and securely clamp conduit to outlet box with bushing on inside and locknut on outside. Provide Thomas and Betts #3800 Efcor 56 series or equivalent threaded malleable iron insulated throat grounding bushings.
- B. Terminate metallic conduits at switchboards, panelboards, control cabinet, etc. with O-Z Electrical Manufacturing Company Type "BL" or "GB" grounding type insulation bushings. Ground bushings to equipment grounding buss.

2.4 OUTLET BOXES

- A. Provide electrical service outlets, including plug receptacles, lamp receptacles, lighting fixtures and switches with Steel City, Raco, or equivalent 4 inch code gauge steel knockout boxes galvanized or sheradized of required depth for service or device.
- B. Provide code gauge galvanized steel raised covers on outlet boxes installed in plaster finish. Set to plaster grounds with outside edge of cover flush with plaster finish.
- C. Provide 3/8" or larger fixture stud in each outlet box scheduled to receive lighting fixture. Select covers with proper opening for device installed in outlet box.
- D. Use of utility or "Handy" boxes acceptable only where single gang flush outlet box in masonry is "dead-end" with only one conduit entering box from end or back.
- E. Use no sectional outlet boxes.

- F. Provide Appleton FS or FD unilets for surface mounted exterior work. Provide complete with proper device cover and gasket. Provide blank cover and gasket when used as junction box.

2.5 PULL BOXES, WIREWAYS AND GUTTERS

- A. Provide Alwalt, Keystone, Universal or equivalent code gauge pull boxes, wireways, and gutters indicated or required for installation, sized to conform with NEC rules. Provide complete with necessary fittings, interconnecting nipples, insulating bushings, conductor supports, covers, gaskets, partitions, etc. as required,
- B. Special items may be fabricated locally, to same general design and specifications as those listed in specified manufacturers catalogs. Provide free of burrs, sharp edges, unreamed holes, sharp pointed screws or bolts, and finished with one coat of suitable enamel inside and out, prior to mounting.
- C. Provide sectional covers for easy removal.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

- A. Conduit materials, by application, shall be as follows:
 - 1. Service entrances, feeders, and branch circuits below grade: Schedule 40 PVC.
 - 2. Exterior above grade feeders service entrances and feeders: Rigid steel. Transition below grade from schedule 40 PVC.
 - 3. Interior branch circuits and feeders: EMT.
- B. In general conceal conduit within walls, floors, roof construction or furred spaces. Expose only feeders and short connections to equipment in equipment rooms unless noted otherwise. Install exposed conduit parallel or at right angles to building lines.
- C. Install conduit to requirements of structure, other work on project and clear of openings, depressions, pipes, ducts, reinforcing steel, etc. Install conduit in concrete forms so that strength of structure will not be affected.
- D. Align conduit terminations at panelboard, switchboards, motor control equipment, junction boxes, etc. and install true and plumb. Provide supports or templates to hold conduit alignment during rough-in stage of work.
- E. Install conduit continuous between outlet boxes, cabinets and equipment. Make bends smooth and even without flattening or flaking conduits. Radius of bends shall not be shorter than radius listed in table 346-1 O(b) of NEC. Long radius elbows may be used where necessary.
- F. Ream and clean conduit before installation, and plug or cover openings and boxes to keep conduit clean during construction.
- G. Install no conduits or other raceways sized smaller than permitted in applicable NEC tables. Where conduit sizes shown on drawings are smaller than permitted by code, the Contractor shall include cost for proper size conduit in his base bid. In no case reduce conduit sizes indicated on drawings or specified without written approval of A/E. Fasten conduit securely in place with approved straps, hangers and steel supports. Provide O-Z cable support to support conductors in vertical raceways as required by NEC Table 300-1 9(a) of NEC. Where special hangers are required, submit hanger details to A/E for review before installation.

3.2 LOCATION OF OUTLET BOXES

- A. Locate outlet boxes generally from column centers and finished wall lines. Install ceiling outlet boxes at suspended ceiling elevations.

- B. Accurately locate lighting fixtures and appliance outlet boxes mounted in concrete or in plaster finish on concrete. Install outlet boxes in forms to dimensions taken from bench marks, columns, walls, or floors. Rough-in lighting fixtures and appliance outlet boxes to general locations before installation of walls and furring and reset to exact dimensions as walls and furring are constructed. Set outlet boxes true to horizontal and vertical finish lines of building. If outlet is shown to be installed in or on a column, outlet shall be centered on column.
- C. Install outlet boxes accessible. Provide outlet boxes above piping or ductwork with extension stems or offsets as required to clear piping and ductwork.
- D. Install centerline of switch outlet boxes 48" above floor unless otherwise called for or required by Wainscot, counter, etc. All electrical light switches shall be located as close to door frame as possible. Under no circumstances should switch be located more than 12' from edge of door frame. Install centerline of receptacle outlet boxes 18" above floor unless otherwise called for on drawings. Adjust mounting heights to nearest masonry joint for minimum cutting in case of flush outlets. All thermostats shall be centered above light switches wherever possible. If switch outlet is shown to be installed in or on a column, switch outlet shall be centered on column.
- E. Install clock and other outlet boxes at elevations indicated on drawings or as directed by A/E. Center bracket lights over mirrors with 2" clearance above mirror.

END OF SECTION 261300

SECTION 261400 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 16010 - General Electrical Requirements, and section 16050 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. Provide Hubbell specification grade NEMA Standard WD-1-1974 grounding receptacles with color as selected by A/E:

TYPE	NEMA	CAT.#	AMP	VOLTAGE
Duplex	5-20R	Hubbell 5352A	20	125
Ground Fault	5-20R	Hubbell GF20	20	125

- B. Provide Hubbell weatherproof receptacles as follows:

WP - Install device in Hubbell RW51040 lift coverplate.
WPI - Install device in Hubbell RW57300 "While-In-Use" cover.

- C. Provide Leviton grounding receptacles as follows:

TYPE	NEMA	CAT#	AMP	VOLTAGE
Combination	10-30	Hubbell RR430F	30	125/250
Combination	10-50	Hubbell RR450F	50	125/250

- D. Equivalent receptacles by Cooper Wiring, Leviton, Pass & Seymour.
E. Provide receptacles in colors as selected by architect or interior designer.

2.2 WALL SWITCHES

- A. Provide Hubbell NEMA Standard WD-1 -1974 switches with compound handles. Install groups of switches under one coverplate.
B. Provide switches in colors as selected by architect or interior designer.
C. Switches controlling loads of 1800 watts or less shall be as follows unless specified otherwise:

TYPE	CATALOG #	AMP	VOLTAGE
Single Pole	Hubbell 1221	20	120/277
Three Way	Hubbell 1223	20	120/277
Four Way	Hubbell 1224	20	120/277
Pilot Light	Hubbell HBL1221PL	20	120/277
Double Pole	Hubbell 1222	20	120/277
Single Pole, Key Op.	Hubbell HBL1221L	20	120/277
Three Way, Key Op.	Hubbell HBL1223L	20	120/277
Four Way, Key Op.	Hubbell HBL1224L	20	120/277

- D. Equivalent switches by Cooper Wiring, Pass & Seymour, Bryant or Leviton.

2.6 FLUSH WALL PLATES

- A. Provide Hubbell type 302 stainless steel wallplates conforming to U.L., NEMA and Federal Specification WP-455A. Verify with architect and/or interior designer prior to ordering and installation.
- B. Provide wallplates for all switches, receptacles, blanks, telephone, computer and special purpose outlets.
- C. Plates shall be modern design, having rounded edges and corners complete with finish-matching mounting screws.
- D. Provide flush wallplates on wiremold switch and receptacle boxes.
- E. Provide factory engraved wallplates where indicated. Where engraved text is not outlined, submit two copies of proposed text to A/E for review and approval prior to engraving.
- F. Wallplates shall not support wiring devices. Provide wiring device accessories as required to properly install devices and wallplates.
- G. Provide jumbo wallplates for all wiring devices installed in masonry walls.
- H. Provide wallplates of one design throughout the building.
- I. Provide designs and finishes equivalent to above specifications where wallplates for special devices are available only from manufacturer of device.
- J. Verify with A/E finish of any plate where it may be apparent a special finish or color should have been specified.
- K. Provide narrow wallplates as indicated.
- L. Ganged wiring devices shall have a single wallplate.
- M. Provide wallplates manufactured by same company as wiring devices.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 261400

SECTION 261450 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 LIGHTING CONTACTORS

- A. Provide 600 volt, 60 cycle mechanically or electrically held lighting contactors with proper NEMA enclosure required by contactor location and environment.
- B. Contactors shall have silver alloy, double break power contacts replaceable without removing power wiring or contactor from enclosure.
- C. Coils shall be molded case construction permanently marked with coil voltage and frequency and be replaceable without removing contactor from enclosure.
- D. Provide contactor with internal wiring and control circuits prewired with only line, load, and external control circuits wiring connections required. Provide contactor with build-in clearing interlocks to allow control from either momentary or maintained pilot devices.
- E. Contactor shall be suitable for addition of at least two electrical interlocks of any arrangement of normally open or closed contacts.
- F. Provide contactor with accessories such as auxiliary contacts, pilot lights, on-off, or H.O.A. switches required to obtain control sequence shown on plans or specified. Accessories shall be available as kits for field installation or modification.
- G. Where three or more contactors are installed at one location contactors may be installed in group control panel in lieu of separate devices.
- H. Contactors by Allen Bradley, Cutler-Hammer, Furnas, ITE, Challenger, Square D or General Electric.
- I. See Schedule.

2.2 PHOTOCELLS AND TIME SWITCHES

- A. Provide photocells and time switches as indicated on drawings and in schedules.
- B. Equivalent by Intermatic, Paragon, Rainbird or Tork.
- C. See schedule.

2.3 OCCUPANCY SENSORS

- A. Provide occupancy sensors and power packs as indicated on drawings and in schedules.
- B. Equivalent by Greengate, Hubbell, Leviton or Wattstopper.
- C. See schedule.

PART 3 - EXECUTION [Not Applicable]

END OF SECTION 261450

SECTION 264100 - SAFETY SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 FUSED DISCONNECT SWITCHES

- A. Provide heavy duty and general duty horsepower rated safety switches rated in accordance with NEMA enclosed Switch Standard KS-1 -1975 and UL 98 Standard and as scheduled.
- B. Enclosure shall be NEMA type required by switch location and environment. Enclosure door shall have latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
- C. Line terminals shall be permanently marked and shielded. Contacts shall be tin plated, equipped with arc chutes and have moving contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and be integral part of box. All current carrying parts shall be plated.
- D. Fuse holders for 1 to 600 amperes shall be high pressure type for use with Class R current limiting fuses. Fuse holders shall be completely accessible from front of switch.
- E. Provide switches by General Electric, or Square D.
- F. See Disconnect Switch Schedule on the drawings.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 264100

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SECTION 264420 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

1.2 SECTION INCLUDES

- A. Lighting and Appliance Panelboard - Furnish and install lighting and appliance panelboard(s) as specified herein and where shown on the associated schedules on the construction drawings.

1.3 REFERENCES

- A. The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.
 - 1. NEMA PB 1 - Panelboards
 - 2. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - 3. NEMA AB 1 - Molded Case Circuit Breakers
 - 4. UL 50 - Enclosures for Electrical Equipment
 - 5. UL 67 - Panelboards
 - 6. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
 - 7. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
 - 8. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
 - 9. Federal Specification W-P-115C - Type I Class 1
 - 10. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
 - 11. NFPA 70 - National Electrical Code (NEC)
 - 12. ASTM - American Society of Testing Materials

1.4 SUBMITTAL AND RECORD DOCUMENTATION

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

1.5 QUALIFICATIONS

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.7 OPERATIONS AND MAINTENANCE MATERIALS

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.8 WARRANTY

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equivalent by Cutler Hammer, General Electric, ITE or Square D.

2.2 POWER DISTRIBUTION PANELBOARDS

- A. I-LINE Circuit Breaker Distribution Panelboard
 - 1. Interior
 - a. Shall be Square D I-LINE type rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedules on the construction drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
 - b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated schedules on the construction drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.
 - c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
 - d. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.
 - e. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
 - f. A solidly bonded copper equipment ground bar shall be provided.
 - g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.
 - h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.
 - 2. Group mounted circuit breakers through 1200A
 - a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
 - b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
 - c. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

- d. Line-side circuit breaker connections are to be jaw type.
- e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- 3. Thermal magnetic molded case circuit breakers:
 - a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
 - b. Circuit protective devices shall be Square D molded case circuit breakers. Circuit breakers shall be standard interrupting. Ampere ratings shall be as shown on the drawings. Manufacturer shall submit one set of published Ip and I_{2t} let-through curves (as required by UL) to the owner.
- 4. Enclosures
 - a. Type 1 Boxes
 - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvanized steel will not be acceptable.
 - 2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
 - 3) Maximum enclosure dimensions shall be 44" wide and 9.5" deep.
 - b. Type 1 Trim Fronts
 - 1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) Trim front shall be hinged 1-piece with door available in surface mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
 - 3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

2.3 LIGHTING AND APPLIANCE PANELBOARD TYPE

- A. NQ or NF
 - 1. Interior
 - a. Shall be type NQ or NF panelboard rated for 240 Vac or 480 Vac as required. Continuous main current ratings, as indicated on associated schedules on the construction drawings, not to exceed 600 amperes maximum.
 - b. Minimum short circuit current rating: as indicated in schedules on the construction drawings.
 - c. Short circuit current rating: As scheduled.
 - d. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 - e. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 - f. A solidly bonded copper equipment ground bar shall be provided.
 - g. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length.
 - h. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.
 - i. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
 - j. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 100A interiors shall be vertically mounted. Main circuit breakers over 100A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
 - 2. Main Circuit Breaker

- a. Shall be Square D type circuit breakers.
 - b. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
 - c. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
 - d. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
 - e. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
 - f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 75° C rated wire sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
 - g. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.
3. Branch Circuit Breakers
- a. Shall be Square D type circuit breakers. Circuit breakers shall be UL Listed with ampere ratings, interrupting ratings, and number of poles as indicated on the associated schedules on the construction drawings.
 - b. Molded case branch circuit breakers shall have bolt-on type bus connectors.
 - c. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
 - d. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
 - e. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 - f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 75° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Branch circuit breakers rated 30 amperes and below shall be UL Listed to accept 60° C rated wire.
 - g. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.
4. Enclosures
- a. Type 1 Boxes
 - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanized steel will not be acceptable.
 - 2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - 3) Box width shall be 26" wide maximum wide.
 - b. Type 1 Fronts
 - 1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) Fronts shall be hinged 1-piece with door. Mounting shall be as indicated on drawings and associated schedules.
 - 3) Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
 - 4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

- c. Type 3R, 5, and 12
 - 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
 - 3) Maximum enclosure dimensions shall not exceed 21" wide and 6.5" deep.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

3.2 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION 264420

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SECTION 265110 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, section 260100 - General Electrical Requirements, and section 260500 - Basic Electrical Materials and Methods shall apply to this Section.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Provide fixtures complete with lamps and accessories required for hanging.
- B. All light fixture installations in fire rated ceilings shall comply with U.L. listing for rated assembly.
- C. See **LIGHTING FIXTURE SCHEDULE** on the drawings.

2.2 LAMPS

- A. Provide inside frosted (IF) incandescent lamps unless otherwise called for in fixture schedule.
- B. Provide General Electric as specified. Equal by Sylvania or Philips.
- C. Fixture lamps shall be lamp type recommended by the Manufacturer. Lamp no fixtures above the Manufacturer's recommended maximum wattages.

2.3 BALLASTS

- A. Fluorescent fixture ballast shall be Class "P" high power factor type (over 90%). Ballast shall comply with Standard C82.a specification for fluorescent ballast and be certified and labeled by "CMB/ETL". Ballast shall have sound rating indicated on ballast case and rated as follows:

BALLAST TYPE	SOUND RATING
Pre-Heat - Rapid Start	A
Trigger Start	A
Instant Start	B
High Output	C
- B. Dimming ballast where required shall be compatible with dimming devices specified.
- C. Ballasts shall be General Electric, Advance, Jefferson or Universal Lighting Technologies. All products shall meet warranty of the specified G.E. ballasts with G.E. lamps.
- D. Provide metal halide fixtures with peak-lead auto-transformer type ballast.

PART 3 - EXECUTION

- 3.1 The Contractor shall insure that lamps, reflectors, trims, and trim are clean at time of final inspection.
- 3.2 Provide recessed fixtures with trim flush to ceilings, free of gaps or cracks.
- 3.3 Coordinate mounting of ceiling mounted lighting fixtures with the Contractor. Where additional ceiling or fixture supports are required due to fixture location or weight they shall be provided by the Contractor, unless otherwise specified under ceiling specifications.

- 3.4 Consult Architectural plans for ceiling types and provide recessed fixtures and mounting components accordingly.
- 3.5 Fixture supports shall comply with 2005 N.E.C. Sections 410-15 and 410-16. Provide fixture securing clips as required.

END OF SECTION 265110

SECTION 266100 - DATA AND COMMUNICATIONS

PART 1 - GENERAL

Unless stated otherwise, all Information Technology (IT) Facility Requirements for the Missouri Department of Conservation (MDC) will conform to Telecommunications Industry Association standards TIA 568-B, TIA 569, TIA 606, and TIA 607. Contractors who agree to meet the specifications set forth in these facility requirements may obtain a complete set of the standards from the Telecommunications Industry Association at www.tiaonline.org.

These standards do NOT in anyway supersede or conflict with building regulations and electrical codes such as the National Electrical Code (NEC) and National Fire Protection Association (NFPA) Code.

1.1 PROJECT PLANNING

- A. MDC's Administrative Services - Information Technology Section must be consulted before any project planning, implementation, or installation is considered complete. All IT specifications for new or renovated building spaces must be reviewed and approved by the IT Section to insure that the building includes all necessary communications facilities.

1.2 PROJECT COORDINATION

- A. All communications relating to a building project and/or IT facility specifications shall be handled through a primary point of contact in the IT Section. Unless notified otherwise, this contact shall be Todd Holt, IT Infrastructure Supervisor at 573-522-4115, extension 3568. Todd can be e-mailed at todd.holt@mdc.mo.gov.

1.3 PROJECT IMPLEMENTATION

- A. All requirements in this document must be strictly followed during the implementation or construction phase. The IT Section must approve any deviations from the specifications listed in this document.

1.4 NETWORK LOCATION

- A. The Dock/Storage Room 107 must have space assigned as the first point of entry for all outside communications cable, as the main distribution point within the building for horizontal and backbone cable, and as the primary location of critical information technology equipment. IT would also ask D&D to provision space in the Dock/Storage Room 107 for communications and cabling for the new building.

1.5 PLYWOOD BACKBOARD

- A. Dock/Storage Room 107
 1. The Dock/Storage Room 107 shall be equipped with one (1) sheet of A/C grade plywood backboard at least 4 feet wide by 4 feet tall by 3/4 inch thick and capable of accepting multiple screw-mounted electronics components weighing up to one hundred and fifty (150) pounds each. This backboard will be placed on the outside wall in the Northwest corner of the room with the bottom edge of the plywood approximately 30 inches above the floor surface. The side edge should be flush with the interior wall. The plywood should be painted the same color as all other wall surfaces with a fire-retardant paint.
 2. Note: Fiber rock composite may not be used as it cannot support components exceeding fifty pounds.

1.6 EQUIPMENT CABINET:

- A. Dock/Storage Room 107 - The general contractor shall equip the Dock/Storage Room 107 with a cabinet. The cabinet shall be a NEMA-styled wall-mounted, swing-out cabinet, 24" wide by 24" deep by 36" tall. Refer to Attachment A for a recommended product. The wall-mounted cabinet shall be mounted to the plywood backboard 24" from the interior wall and 4" from the bottom of the plywood (see Section 2.1). The cabinet swing should swing away from the interior wall.

1.7 POWER REQUIREMENTS:

- A. Dock/Storage Room 107 - The general contractor shall provide one (1) 20-amp duplex outlet in the Dock/Storage Room 107 below the plywood mounting surface (see Section 2.1). This single 20-amp duplex outlet should be placed below the equipment cabinet to supply power to electronics components mounted in the cabinet. The duplex outlet shall be on a dedicated 20-amp circuit with a NEMA 5-20R 125V, 20A straight blade connector.

1.8 CEILING:

- A. No ceiling shall installed above the working area of NEMA styled network equipment box in the Dock/Storage Room to allow for easy access to network cables and cable runs.

1.9 FLOORING:

- A. There are no requirements for the flooring in the Workshop.

1.10 ENTRANCE CONDUIT:

- A. The general contractor shall provide two (2) 2-inch conduits for copper and fiber entrance facilities from the Network Room of the Brown Trout Building to the Dock/Storage Room located north of the Nature Center. These conduits should emerge on the North Side of the Dock/Storage Room by the Network Rack (see Diagram A).

1.11 GROUNDING & BONDING:

- A. 2.7.1 Dock/Storage Room 107

- 1. The general contractor must provide a Telecommunications Grounding Busbar (TGB) in the Electrical Room in compliance with ANSI/TIA/EIA-607 and NEC. The TGB shall be mounted at the bottom of the plywood backboard in the IT Room and be large enough to accommodate at least four (4) connections for communications equipment and telephone company terminals. One end of the bonding conductor shall be connected to the TGB with a two-hole compression lug and the other end shall terminate directly to an electrical panel. The conductor shall consist of green #6 AWG (or larger) copper cable.

PART 2

2.1 HORIZONTAL VOICE AND DATA CABLE

- A. Horizontal cabling provides the interconnection from a workstation to the network room or communications closet. The general contractor shall be responsible for provisioning, installing, and testing all horizontal voice and data cabling according to the following specifications.

2.2 CABLE TYPE

- A. All horizontal voice and data cable shall be unshielded and consist of four (4) twisted pair #22 or #23 AWG solid copper conductors, **be rated as enhanced Category 6e-plus** and meet all Category 6-compliant specifications capable of supporting signals of no less than 250 Mhz. All cables shall be blue for easy identification. Refer to Attachment B for a recommended product.

Note 1: Category 6 specifications are found in ANSI/TIA/EIA-568-B.2-1 standards document available at www.tiaonline.org.

Note 2: The contractor shall provision plenum-rated horizontal voice and data cable on this project.

2.3 WORKSTATION OUTLETS

- A. All horizontal voice and data cables shall be terminated by the general contractor in **Category 6e-plus-rated** RJ-45 outlets using the T568B color-coding scheme. All outlets shall be orange for easy identification. RJ45 jacks may be seated in flush-mounted wall or floor faceplates, modular furniture raceway modules, in ceilings with just a RJ-45 outlet or surface-mounted outlet boxes as circumstances warrant. Refer to Attachment C for a required product (see Note below).
- B. IMPORTANT: IT maintains a large inventory of communications parts and materials. For this reason, IT requires the contractor to provide the exact make and model of outlets specified in Attachment C to match the equipment maintained in all MDC locations. Outlets of equivalent rating from different manufacturers may not be used.

2.3 OUTLET QUANTITY

- A. The general contractor shall install (43) communications outlets in the Nature Center for a total of 51 cable pulls. There are 27 Single 18" AFF outlets, 3 Single 60" AFF outlets, 8 Dual 18" AFF outlets, 4 Single outlets above the Drop Ceiling with just a female RJ-45 Jack and 1 surface mount outlet. Refer to Diagram A for the outlet locations on the main floor. Refer to Diagram B for the outlet locations in the basement. All outlets shall be 18" AFF unless noted separately in Diagram A or Diagram B. Dual Jacks are noted as two ports with a line above the two ports. Also note that one run will be made to the basement.

2.4 CABLE LENGTHS/CONTINUITY

- A. Data horizontal cable runs from the Dock/Storage Room to the workstation outlets must not exceed 295 feet (90 meters) and must not contain splices
- B. Important: All horizontal voice and data cables must contain a service loop with at least six (6) additional feet of cable length at the Dock/Storage Room and the workstation end. This service loop should be placed a) near the ceiling if cables enter the room from above or, b) near the conduit opening if emerging from the floor. Service loops should not be located too close to the cable terminating equipment (see Section 3.5). The purpose of the service loop is to provide a technician with the flexibility to relocate terminating equipment.

2.4 CABLE TERMINATING EQUIPMENT

- A. The general contractor shall terminate all horizontal cable runs in a 24-port or 48-port rack-mounted **Category 6e-plus-rated** universal Type 110 data patch panel. Cables shall be terminated using the T568B color-coding scheme. Where feasible, the patch panel(s) shall be mounted in the upper one-third of the equipment rack to allow for mounting of additional hardware at lower levels. Refer to Attachment D for the required product.
- B. IMPORTANT: IT maintains a large inventory of communications parts and materials. For this reason, IT requires the contractor to provide the exact make and model of data patch pane specified in

Attachment D to match the equipment maintained in all MDC locations. Patch panels of equivalent rating from different manufacturers may not be used.

2.5 HORIZONTAL CABLE NUMBERING

- A. The general contractor shall designate all data horizontal cable runs by the corresponding two-digit position on the patch panel (see Section 3.5). For example, the cable terminated in patch panel port No. 1 would be labeled as "D1." This cable number shall be typed or written on an adhesive label and affixed within 12 inches on both ends of each horizontal data cable run and printed on the outlet faceplate or surface-mount housing. The contractor shall use a portable label maker for numbering outlets. Numbers must not be hand written on the outlets. Runs on the second patch panel will start with the ending number of the previous patch panel plus the port number in the current patch panel. For example, a run in port one of the second patch panel with a fully populated forty-eight port patch panel would be labeled port 49.

2.6 CABLE TESTING

A. Test Procedures:

The general contractor shall be responsible for performing Basic Link Tests (from outlet to terminating equipment) on all **Category 6e+** voice and data horizontal cables using a certified and properly calibrated Level II field tester. All field testers must be updated with the most recent testing parameters based on the requirements in ANSI/TIA/EIA-568-B.2-1. Cables that fail these standards-based tests must be repaired or replaced by the contractor before MDC assumes ownership of the cable.

B. Test Results:

The contractor shall provide MDC-IT test results in hardcopy or electronic format within one week of testing. Test results may be mailed to: Missouri Department of Conservation, Attn.: Network Coordinator, P.O. Box 180, Jefferson City, MO 65102-0180 or e-mailed to todd.holt@mdc.mo.gov.

1. Cable Diagrams:

The general contractor shall provide MDC-IT with a complete set of floorplans showing all horizontal voice and data cable outlets with their assigned outlet numbers.

C. Inter-building Cabling Requirements:

1. IT would like that a general contractor, the general's sub-contractor, or a third-party cabling contractor provide the following labor and materials described in Section 4.

2. Inter-building Data and Voice Cabling:

a) Cable Type:

The contractor shall provide and install a 12-strand, graded-index, outdoor-rated, loose-end optic cable with nominal 50/125 OM4 micron core/cladding diameter complying with the ANSI/TIA/EIA 568-B.3.1 standard. The cable shall extend from the Network Room of the Brown Trout Building to the Dock/Storage Room of the Nature Center and terminate into fiber optic panels at both ends (see Section 4.2.4). The total cable distance is estimated to be approximately **500 feet**, including the service loop (see Section 4.2.2). It shall be the contractor's responsibility to determine the exact length of cabling required to inter-connect the two buildings. Refer to Attachment F for an example of the preferred cable.

b) Service Loop:

The contractor shall provision a 25-foot service loop at both ends of the inter-building optical cable (Section 4.1.1). This cable shall be coiled and hung adjacent to the equipment cabinet.

c) Cable Supports:

The contractor shall provide and install J-hooks or other cable management hardware to support the cable in the Brown Trout Building from the conduit penetration in the Dock/Storage Room. This distance is estimated at less than 5 feet.

d) Fiber Cable Terminating Equipment:

The contractor shall provide and install a rack-mounted fiber optic patch panel in the wall-mounted equipment cabinets in both the Dock/Storage Room and Brown Trout Building. The contractor shall use LC type connectors. The contractor shall place the fiber optic panel at the very top of the equipment cabinets in the Dock/Storage Room. Space maybe available in the existing fiber patch panel in the Brown Trout Building. If not, a new patch panel will need to be placed in the next empty space available from the top of the rack. The contractor shall provide mounting plates for twelve (12) fiber strands in both fiber panels. Refer to Attachment G for the preferred products.

e) Fiber Optic Cable Tests:

The contractor shall be responsible for performing Basic Link Tests (between terminating equipment) on all fiber optic strands using a certified and properly calibrated power meter and light source. All field testers must be updated with the most recent testing parameters based on the requirements in ANSI/TIA/EIA-568-B.3. Cables that fail these standards-based tests must be repaired or replaced by the contractor before MDC assumes ownership of the cable. The contractor shall provide MDC-IT test results in hardcopy or electronic format within one week of testing. Test results may be mailed to: Missouri Department of Conservation, Attn.: IT Infrastructure Supervisor, P.O. Box 180, Jefferson City, MO, 65102-0180 or e-mailed to todd.holt@mdc.mo.gov.

f) Voice Cabling:

1. Cable Type:

The contractor shall provide and pull a 25-pair, Category 3, outdoor-rated copper cable from the Network Room in the Brown Trout building to the Dock/Storage Room in the Nature Center and terminate the cable on the new building entrance terminals at both ends. A service loop of 25 feet will be mounted on the wall of the Education/Observation Building Media Room Plywood Backboard on the end of the backboard closest to the door. The total cable distance with the service loop is estimated to be **500 feet**. Refer to Attachment H for an example of the preferred cable.

2. Pull Rope:

The contractor shall provide and install one nylon pull rope with the copper cable that has a sufficient length at each end of the conduit to allow for future cable pulls.

3. Voice Cable Terminating Equipment:

The contractor shall provide and install a 25-pair building entrance terminal (BET) at Nature Center and the Brown Trout Building of the voice cable. The contractor shall install the BET in the Nature Center on the new plywood backboard. The contractor shall install the BET in the Brown Trout Building on the existing plywood backboard. The contractor shall also provide and install 5-pin solid-state surge protection modules in the following quantities: twelve (12) normal-voltage black, and thirteen (13) low-voltage red modular surge protectors in each BET (see Note below). Refer to Attachment I for an example of the preferred BET and surge suppression modules.

Note: The vendor must provide 5-pin modules like the ones shown in Attachment I.

g) Intra-Building Raceways:

The general contractor shall provision and install cable raceways for the proper support and routing of horizontal cables and backbone cables located on the same floor. Raceways may be above-ceiling, below-floor, or a combination of both. Refer to Attachment E for a recommended above-ceiling product.

3. Accessibility:

Closed conduit systems such as metal flex conduit or PVC may not be used as raceways for cables on the same floor. Raceways shall be "open" to allow greater accessibility for installation and maintenance as follows:

4. Above-Ceiling:

Unless removable ceiling tiles are provided, the general contractor shall install ceiling hatchways to permit installers access to the above-ceiling raceway system. Access shall not be less than 50 feet apart for all spans greater than 50 feet.

5. Below-Floor:

The general contractor shall install floor access panels at all duct junctions, and access holes at intervals along duct to provide access to all cable runs. Access shall be not less than 50 feet apart for all spans greater than 50 feet.

a)Size:

Cable raceways shall be of sufficient size so that all cables supported shall be less than 40% of the raceway capacity. The 40% fill rate is a requirement of the NEC code for low voltage distribution systems.

b)Location:

Cable trays will be installed so as to maximize clearance from all electric lights and other sources of electromagnetic interference such as electric motors, HVAC equipment, etc.

c)Supports:

Cable trays supports should be located on 48 to 60 inch centers.

Attachment A

**IT Facility Specifications
Wall-mounted Swing Cabinet**

The following product would be suitable for housing data communications equipment, fiber optic termination panels, and patch panels in a Communications Closet.

TE

References: Section 2.2.

Preferred Brand:

Chatsworth Products, Inc.

Description:

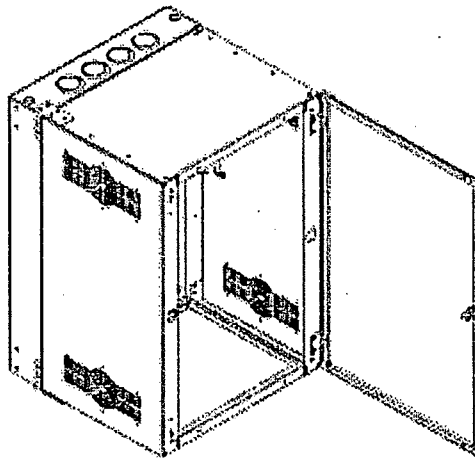
Wall-mount Cabinet

Mfr. Part No.:

11900-224 = 24"W x 24"H x 24"D w/ Plexiglass door

11900-236 = 24"W x 36"H x 24"D w/ Plexiglass door

11900-248 = 24"W x 48"H x 24"D w/ Plexiglass door



For more product information, go to:

http://www.chatsworth.com/uploadedFiles/Filas/cube-it_datasheet.pdf.

**Attachment B
IT Facility Specifications
Horizontal Voice/Data Cables**

The following 4-pair, #23 AWG, unshielded twisted pair (UTP) **Category 6e-plus** communications cable is suitable for all horizontal voice and data cable runs. Plenum-rated cable is required where ceiling plenums are used for return air circulation.

References: Section 3.1.

Preferred Brand: **Superior Essex NextGain® Category 6eX Cable** in 1000 ft. pop box
Mfr. Part No.: **54-272-2A** non-plenum blue
54-246-2B plenum blue



Additional product information may be found at

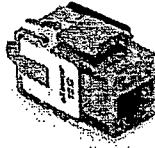
<http://ce.superioressex.com/uploadedFiles/Docs/PDF/Catalogs/Communications/NextGain-CAT6eX.pdf>

**Attachment C
IT Facility Specifications
Voice/Data Outlets and Faceplates**

The following products are required for use as voice and data communications outlets in MDC Offices. **All outlets shall be orange.**

Reference: Section 3.2.

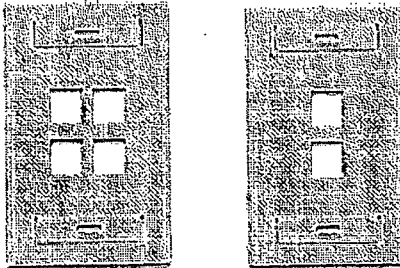
Preferred Brand: **Leviton eXtreme™ 6+ QuickPort® Snap-in Connectors**
Mfr. Part No.: **61110A-R06**



Additional Product can be found at http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber=61110-RO6§ion=39154

The Leviton eXtreme™ QuickPort® Snap-in Connectors are used with QuickPort® single- and double-gang faceplates. The following products are suitable for use with the connectors shown above.

Preferred Brand:	Leviton QuickPort®
Description:	Single-gang Faceplate w/ Designation Window
Part No.:	(1) 41080-4IP 4-port Plate, ivory or (2) 41080-2IP 2-port Plate, ivory

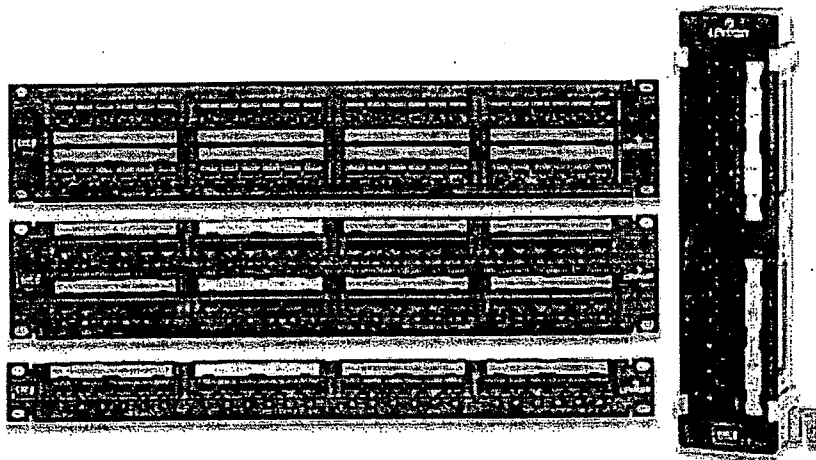


Additional product information can be found at
http://www.leviton.com/OA_HTML/SectionDisplay.jsp?section=39412

Attachment D
IT Facility Specifications
Data Type 110 Patch Panel

The following products are recommended for terminating data horizontal cable runs in a floor or wall-mounted rack in a Network Room or Communications Closet.

Reference:	Section 3.5
Preferred Brand:	Leviton eXtreme™ 6+ Universal Patch Panel
Mfr. Part No.:	69586-U48 48-port Unit 69586-U24 24-port Unit



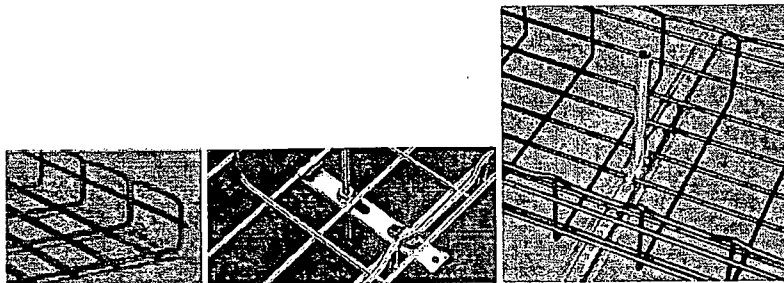
For more product information, refer to:
http://www.Leviton.com/OA_HTML/ibcGetAttachment.jsp?cltemId=83439.

Attachment E IT Facility Specifications Cable Tray System

The following items are recommended as above-ceiling cable raceways in MDC buildings for the support of both horizontal and backbone cables.

Reference: Section 6.3

Preferred Brand: GS Metals Flextray™
 Part No.: See below

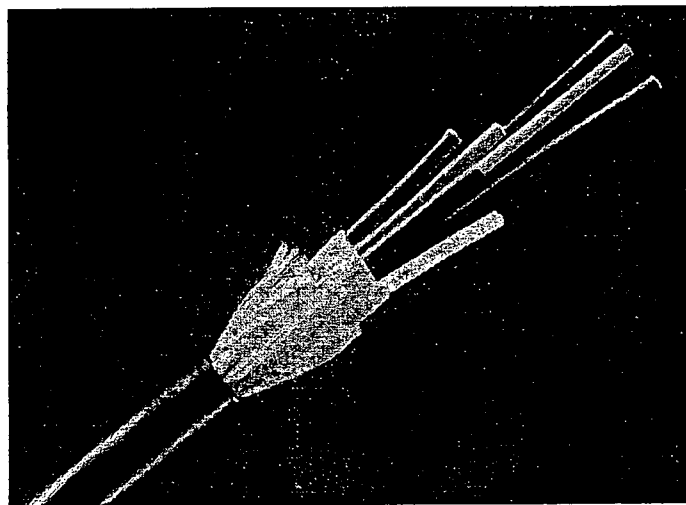


For more information on cable tray sizes, connectors, components, and installation guide, refer to <http://www.flextray.com/>.

Attachment F
Branson Workshop Inter-building Cabling Requirements
Outdoor Fiber Backbone Cable

The following fiber optic cable is recommended for backbone cable between the Brown Trout Hatchery building and the Branson Nature Center at the Missouri Department of Conservation's Branson Hatchery.

Reference:	Section 4.1.1.
Preferred Brand:	Superior Essex
Mfg. Part No.:	L3012NW01



More product information and additional strand-count cables may be found at

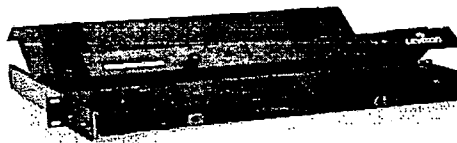
<http://ce.superioressex.com/uploadedFiles/Docs/PDF/Catalogs/Communications/IO-Inter-Arm-Tight-Buffer.pdf>

Attachment G
Workshop Inter-building Cabling Requirements
Fiber Optic Panels and Plates

The following rack-mounted panel is recommended for terminating inter-building fiber optic backbone cable in both the Brown Trout Building and the Workshop at the Missouri Department of Conservation's Branson Office.

Reference: Section 3.2.4.

Preferred Brand: Leviton Opt-X™ 1000i Fiber Optic Systems
Description: Rack-mount Fiber Optic Patch Panel (empty)
Mfr. Part No.: 5R1UM-F03



Additional product information can be found at
http://www.leviton.com/OA_HTML/ProductDetail.jsp?partnumber=5R1UM-F03§ion=39253

Preferred Brand: Leviton Opt-X™ Fiber Optic Systems
Description: Fiber Optic LC Adapter Plate
Mfr. Part No.: 5F100-2LL
Preferred Color: Yellow



5F100-2LL

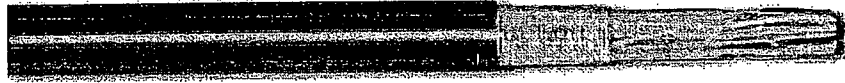
Attachment H
Branson Workshop Inter-building Cabling Requirements
Outdoor Copper Backbone Cable

The following outdoor-rated, gel-filled cable is suitable for the voice inter-building cabling between the Missouri Department of Conservation's Brown Trout Hatchery Building and the Nature Center.

Reference: Section 3.1.1.

Preferred Brand: Superior Essex

Mfg. Part No.: 04-062-21 SealPic® F 25-pair, 22 AWG, twisted pair



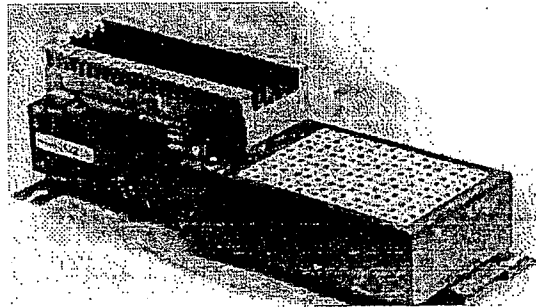
Additional details and part numbers for various pair-count cables can be found at
<http://ce.superioressex.com/uploadedfiles/docs/pdf/catalogs/communications/sealpic-f.pdf>

Attachment I
Branson Workshop Inter-building Cabling Requirements
Building Entrance Terminal
Surge Suppression Modules

The following products are required for protection against power spikes and surges on inter-building copper cable. This equipment would be placed on both ends of copper cable between the Brown Trout Hatchery and the Branson Workhouse at the Missouri Department of Conservation's Branson Office. An equal number of normal-voltage (black) and low-voltage (red) surge protection modules must be installed in each building entrance terminal.

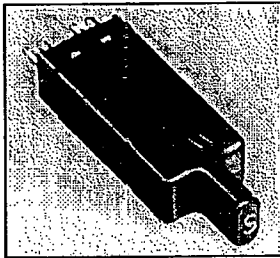
Reference: Section 3.1.5.

Preferred Brand: Comm Omni Circa Building Entrance Terminal
Mfr. Part No.: 2625QC/QC (Type 66 in/Type 66 out)



For more product information refer to <http://www.comm-omni.com/circa/2625qc.htm>.

Preferred Brand: CommScope 5-pin Surge Protection Module
Mfr. Part No.: 4C1S Black (Normal Voltage)
4C3S-75 Red (Low Voltage w/ Heat Coil)



END OF SECTION 266100

SECTION 269000 FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.
- B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
- D. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- E. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.
- F. Approved manufacturers: Notifier, Siemens, Simplex and EST.

1.2 SCOPE

- A. Basic Performance:
 - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
 - 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
 - 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

B. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

- 1. The system alarm LED on the system display shall flash.
- 2. A local piezo electric signal in the control panel shall sound.
- 3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
- 4. History storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
- 5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.3 SUBMITTALS

A. General:

1. Refer to electrical submittal requirements included with the General Electrical Requirements specifications section, for additional submittal requirements, including quantity of submittals that shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.
4. Include detailed battery and voltage drop calculations.
5. Submit drawings to identify all device locations. Submitted Plans/Drawings shall include A/V and all visual-only device audible and visual output ratings (decibel and candela) for each device location.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications:

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

E. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTY

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5 POST CONTRACT MAINTENANCE

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.
- C. Maintenance and testing shall be on a semiannual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 - 1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water-flow switches and all accessories of the fire alarm system.
 - 2. Each circuit in the fire alarm system shall be tested semiannually.
 - 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.6 POST CONTRACT EXPANSIONS

- A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.
- B. As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).
- C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.
- D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification appliances connected to the addressable monitor/control modules.
- E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7 APPLICABLE STANDARDS AND SPECIFICATIONS

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

- A. National Fire Protection Association (NFPA) - USA:
 - No. 13 Sprinkler Systems
 - No. 2001 Clean Agent Extinguishing Systems
 - No. 72 National Fire Alarm Code
 - No. 101 Life Safety Code
- B. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Water-flow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 217	217 Smoke Detectors, Single and Multiple Station
NO. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 60951	Safety of Information Technology Equipment

- C. Local and State Building Codes.
- D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
UL Underwriters Laboratories Inc
- B. The fire alarm control panel shall meet UL Standard 864 Ninth Edition (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).
- C. The system shall be listed by the national agencies as suitable for extinguishing release applications. The system shall support release of high and low pressure CO2.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE

- A. Conduit:
 - 1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
 - 2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
 - 3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760.
 - 4. Wiring for 24 volt DC control, alarm notification, emergency communication and

similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 3/4-inch [19.1 mm] minimum.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits, Signaling Line Circuits, and Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water-flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:
 - a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
 - b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
2. Alarm Silence Switch:

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The

selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:
The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
4. System Reset Switch:
Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
5. Lamp Test:
The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personnel.

C. System Capacity and General Operation

1. Refer to construction documents fire alarm system diagram, for control panel or each network node's intelligent/addressable device capacity. If intelligent point or addressable device capacity is not shown on construction documents, prior to bidding, contractor shall contact engineer for requirements.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
4. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.
5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
8. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector sensitivity test, meeting requirements of NFPA 72.
 - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. The ability to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS presignal, meeting NFPA 72 requirements.
 - h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 requirements for activation of notification circuits within 10 seconds of initiating device activation.
 - i. Periodic detector test, conducted automatically by the software.
 - j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.

- k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day/night automatic adjustment of detector sensitivity.
 - o. Device blink control for sleeping areas.
 - 9. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
 - 10. Network Communication
 - a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.
- D. Central Microprocessor
 - 1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
 - 2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
 - 3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
 - 4. A special program check function shall be provided to detect common operator errors.
 - 5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
 - 6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.
- E. System Display
 - 1. The system shall support the following display mode options:
 - a. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.
 - 2. The display shall provide all the controls and indicators used by the system operator:
 - a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
 - 3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
 - 4. The display shall also provide Light-Emitting Diodes.
 - a. The 80-character display shall provide 12 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL,

SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.

5. The display shall have QWERTY type keypad.
 - a. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
 6. The system shall support the display of battery charging current and voltage on the 80-character LCD display.
- F. Signaling Line Circuits (SLC)
1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
 2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
- G. Serial Interfaces
1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
- H. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
 2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
 3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.
- I. Power Supply:
1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
 2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
 3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 200 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
 4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
Ground Fault LED
AC Power Fail LED
NAC on LED (4)
 5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
 6. The main power supply shall provide a battery charger using dual-rate charging

techniques for fast battery recharge and be capable of charging batteries up to 200 AH.

7. All circuits shall be power-limited, per UL864 requirements.

J. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Reed: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values
 - e. Device zone assignments
 - f. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
11. Waterflow Operation

An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

12. **Supervisory Operation**
An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. **Signal Silence Operation**
The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.
14. **Non-Alarm Input Operation**
Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

2.4 SYSTEM COMPONENTS

- A. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:
 1. The maximum pulse duration shall be 2/10 of one second
 2. Strobe intensity shall meet the requirements of UL 1971.
 3. The flash rate shall meet the requirements of UL 1971.
- B. Horn/Strobes:
 1. Operate on 24 VDC
 2. Have two selectable tone options of temporal 3 and non-temporal continuous pattern.
 3. Have at least 2 audibility options
 4. Maximum Pulse Duration: 0.2 second.
 5. Strobe Intensity: UL 1971.
 6. Flash Rate: UL 1971.
 7. Strobe Candela Rating: Determine by positioning selector switch on back of device.
- C. Waterflow Indicator:
 1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
 2. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
 3. All waterflow switches shall come from a single manufacturer and series.
 4. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
 5. Where possible, locate waterflow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.
- D. Sprinkler and Standpipe Valve Supervisory Switches:
 1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, end test and drain valves shall not be equipped with supervisory switches.
 2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
 3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
 4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
 5. The switch housing shall be finished in red baked enamel.
 6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its

mounting.

7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.
 - a. This unit shall provide for each zone: alarm indications, using a red alarm and yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.
 - b. Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal silence, and global system reset within the confines of all applicable standards.

E. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
7. The system shall allow a minimum of 32 terminal mode LCD annunciators that shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a key switch or password.
8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.
4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
5. Communication shall include vital system status such as:
 - Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - Independent Addressable Device Status
 - AC (Mains) Power Loss
 - Low Battery and Earth Fault
 - System Off Normal
 - 12 and 24 Hour Test Signal
 - Abnormal Test Signal (per UL requirements)
 - EIA-485 Communications Failure
 - Phone Line Failure
6. The UDACT shall support independent zone/point reporting when used in the Contact ID-format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

7. AN IP Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet to a compatible receiver.
- G. Door Holders. Finish shall be as selected by architect.
- H. Field Wiring Terminal Blocks
For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.
- H. Control Modules or Relays
 1. Provide fire alarm system control modules or relays that meet electrical requirements of electrical load controlled. Provide coil voltage and contacts as required for required control sequence.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
- B. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8

inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

C. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

D. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

E. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For multiple 2-wire smoke detector circuit monitoring a module shall be available that provides 6 Style B or 3 Style D input circuits.

F. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y. For speaker applications the module is rated for 50 watts at 25 or 70.7 Vrms.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. For multiple circuit control a module shall be available that provides 6 Style B or 3 Style D control circuits.

G. Addressable Releasing Control Module (Not applicable only to projects. Refer to Construction Documents).

1. An addressable FlashScan releasing module shall be available to supervise and control compatible releasing agent solenoids.
2. The module shall operate on a redundant protocol for added protection.
3. The module shall be configurable for Style Z or Style Y (Class A/B) and support one 24 volt or two 12 volt solenoids.

H. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The module shall provide two form C relays rated at up to 3 Amps

resistive and up to 2.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.

2. For multiple relay control a module shall be available that provides 6 programmable Form-C relays.

2.6 BATTERIES

- A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
- C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.
- E. Provide fire alarm system control wiring, and installation of fire alarm system relay or control modules where required to control fire smoke dampers, door holders, relief vents or other loads as indicated on construction documents. Where fire smoke dampers are shown, refer to mechanical plans and coordinate with mechanical contractor for quantities and locations.

3.2 TEST

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all water flow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- K. When the system is equipped with optional features, the manufacturer's manual shall be

consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION 269000

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Stripping and stockpiling rock.
 - 6. Removing above- and below-grade site improvements.
 - 7. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.
 - 8. Temporary erosion and sedimentation control.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
- C. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction as indicated on Drawings.

- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Architect.

- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by Owner.
- D. Utility Locator Service: Notify One Call for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and Section 024119 "Selective Structure Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 3 inches (75 mm) in diameter, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
 2. Do not stockpile topsoil within protection zones.
 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot (300 mm) across in least dimension. Do not include excavated or crushed rock.
 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
 1. Limit height of rock stockpiles to 60 inches (1500 mm).
 2. Do not stockpile rock within protection zones.
 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
 4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

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SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, and pavements.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.

- B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" and Section 013233 "Photographic Documentation" for recording preexcavation and earth-moving progress.
2. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 311000 "Site Clearing" for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
5. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."
- B. Quantity allowances for earth moving are included in Section 012100 "Allowances."
- C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
 1. 24 inches outside of concrete forms other than at footings.
 2. 12 inches outside of concrete forms at footings.
 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 5. 6 inches beneath bottom of concrete slabs-on-grade.
 6. 6 inches beneath pipe in trenches, and 24 inches wider than pipe.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving or concrete.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from on- or off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by conventional earth-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 50 blows/inch when tested by a geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at Project site.
 - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches.
 - 2. Warning Tape: 12 inches long; of each color.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each borrow material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.
- C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Utility Locator Service: Notify Missouri One Call for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- F. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, CL, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Liquid Limit: < 50.
 - 2. Plasticity Index: < 25.
- C. Unsatisfactory Soils: Soil Classification Groups OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 3 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M O; with at least 95 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and less than 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clay, sandy clay, gravelly clay, or clayey sand or gravel with a minimum of 25% passing a #200 sieve capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 - b. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 - c. Tear Strength: 56 lbf; ASTM D 4533.
 - d. Puncture Strength: 56 lbf; ASTM D 4833.
 - 3. Apparent Opening Size: No. 60 (0.250-mm sieve, maximum; ASTM D 4751.
 - 4. Permittivity: 0.2 per second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - b. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - c. Tear Strength: 90 lbf; ASTM D 4533.
 - d. Puncture Strength: 90 lbf; ASTM D 4833.
 - 3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 - 4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150/C 150M, [Type I].
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33/C 33M, #10 sieve nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869/C 869M.
 5. Water: ASTM C 94/C 94M.
 6. Air-Entraining Admixture: ASTM C 260/C 260M.
- B. Produce low-density, controlled low-strength material with the following physical properties:
1. As-Cast Unit Weight: 60 to 80 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
 2. Compressive Strength: 200 psi, when tested according to ASTM C 495/C 495M.
- C. Produce conventional-weight, controlled low-strength material with 200 psi compressive strength when tested according to ASTM C 495/C 495M.

2.4 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. If necessary, install a dewatering

system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. The Contractor is responsible for all necessary dewatering that site conditions may require and the cost of which should be included in the Contractors bid for the project.

3.3 EXPLOSIVES

- A. Explosives: The use of explosives is prohibited at this site.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and 24 inches wider than pipe.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 - 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and 24 inches wider than pipe wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch . If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a fully loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2000 psi, may be used when approved by Architect.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.

4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring, bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 24 inches bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing. Pipe should be tied down to prevent floating.
- G. Final Backfill:
1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 9 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 2. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
1. Turf or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight according to ASTM D 698.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.

3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D-1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes soil treatment for termite control.

1.2 SUBMITTALS

- A. Product data: For each product indicated, including EPA-Registered Label.
- B. Product certificates.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
 - 1. Date and time of application
 - 2. Moisture content of soil before application.
 - 3. Brand name and manufacturer of termiticide.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes, and rates of application used.
 - 6. Areas of application.
 - 7. Water source for application.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: A pest control operator who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.4 WARRANTY

- A. Soil Termiticide Special Warranty: Manufacturer's standard form, signed by applicator and Contractor, certifying that applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered within one year from date of Substantial Completion, re-treat soil and repair or replace damage caused by termite infestation.

1.5 TERMITE CONTROL

- A. Soil Treatment: EPA-registered termiticide complying, with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent. Use only soil treatment solutions that are not harmful to plants.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AgrEvo Environmental Health, Inc.; a company of Hechst and Schering, Berlin.
 - 2. American Cyanamid Co.; Agricultural Products Corp.; Specialty Products Department.
 - 3. Bayer Corp.; Farden & Professional Care.
 - 4. DowElanco.
 - 5. FMC Corp.; Pest Control Specialties.
 - 6. Zeneca Professional Products.

1.6 PREPARATION

- A. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

1.7 SOIL TREATMENT APPLICATION

- A. Apply soil treatment at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label
 - 1. Mix termiticide solution to a uniform consistency
 - 2. Apply to produce a continuous horizontal and vertical termiticidal barrier or treated zone around and under building construction. Distribute the treatment evenly.
 - 3. Slabs on Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs and an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 4. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around interior column footers, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 5. Masonry: Treat Voids.
 - 6. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect Termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping or other construction activities following application.

END OF SECTION 313116

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold milling of existing asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt overlay.
 - 5. Asphalt curbs.
 - 6. Asphalt traffic-calming devices.
 - 7. Asphalt surface treatments.
- B. Related Requirements:
 - 1. Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
 - 2. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
 - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
 - 4. Section 321400 "Unit Paving" for bituminous setting bed for pavers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
 - 2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - 3. Job-Mix Designs: For each job mix proposed for the Work.
- B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
 1. Paving Fabric: 12 by 12 inches minimum.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Material Certificates: For each paving material that includes a statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer approved by the Missouri DOT.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Missouri DOT for asphalt paving work.
 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 1. Prime Coat: Minimum surface temperature of 60 deg F.
 2. Tack Coat: Minimum surface temperature of 60 deg F.
 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

- C. Fine Aggregate: ASTM D 1073 , sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242/D 242M rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, PG 58-28 .
- B. Asphalt Cement: ASTM D 3381/D 3381M for viscosity-graded material.
- C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-70.
- D. Emulsified Asphalt: Prime Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- G. Water: Potable.
- H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D 1073 , Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D 6690 , Type I, Type II or III, Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent or more than 50 percent by weight.
 - 1. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by Mo DOT and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 2. Base Course: Asphalt Base.
 3. Surface Course: Surface Tack Coat.
- C. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1, Type 2 or Type 3.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to a depth of 1-1/2 inches.
 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
 7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
 8. Keep milled pavement surface free of loose material and dust.
 9. Do not allow milled materials to accumulate on-site.

3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. .
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. . Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth . Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.

- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. .
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

- A. Apply asphalt binder uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. .
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches .
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.7 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at a minimum temperature of 250 deg F .
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches .
 3. Offset transverse joints, in successive courses, a minimum of 24 inches .
 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.
 - 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
 - 1. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.11 ASPHALT TRAFFIC-CALMING DEVICES

- A. Construct hot-mix asphalt speed bumps over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F.
 - 1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 2. Asphalt Mix: Same as pavement surface-course mix.
 - 3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch from top of pavement to a clean, rough profile.

- B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.12 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
- C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.13 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
 - 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.

- b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

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SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Concrete Paving for the following areas:
 - 1. Driveways.
 - 2. Roadways.
 - 3. Parking lots.
 - 4. Curbs and gutters.
 - 5. Walks.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete".
 - 2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving Subcontractor.

- e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Laboratory Test Reports: For concrete paving mixtures, documentation indicating that cured concrete complies with Solar Reflectance Index requirements.
- C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: 10-lb sample of each mix.
- E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer of stamped detectable warnings ready-mix concrete manufacturer, and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 ; deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn

- J. Deformed-Steel Wire: ASTM A 1064/A 1064M.
- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A; coated, deformed.
- L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60 ; deformed.
- D. Hook Bolts: ASTM A 307, Grade A , internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780/A 780M.

2.4 CONCRETE MATERIALS

- A. Regional Materials: Concrete shall be manufactured within 100 miles (800 km) of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Regional Materials: Concrete shall be manufactured within 100 miles of Project site.
- C. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I.
 - 2. Fly Ash: ASTM C 618, Class C.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
 - 4. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IP, portland-pozzolan or Type IL, Portland-limestone cement.
- D. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1/2 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- E. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
1. Aggregate Sizes: 3/4 to 1 inch nominal.
- F. Air-Entraining Admixture: ASTM C 260/C 260M.
- G. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- H. Water: Potable and complying with ASTM C 94/C 94M.

2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.
- B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.7 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
- F. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.8 STAMPED DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
 - 1. Size of Stamp: One piece, matching detectable warning area shown on.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.

3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 4 1/2 percent plus or minus 1-1/2 percent for 1 1/2 3/4-inch nominal maximum aggregate size.
 2. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.
 3. Air Content: 5 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture plasticizing and retarding admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- G. Concrete Mixtures: Normal-weight concrete.
1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum W/C Ratio at Point of Placement: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Solar Reflectance Index: Not less than 29.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 DETECTABLE WARNING INSTALLATION

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."
 1. Tolerance for Opening Size: Plus 1/4 inch.
- B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.
- C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
 1. Before using stamp mats, verify that the vent holes are unobstructed.
 2. Apply liquid release agent to the concrete surface and the stamp mat.
 3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
 4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by curing compound as follows:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch .
 - 3. Surface: Gap below 10-feet- long; unlevel straightedge not to exceed 1/2 inch .
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch .
 - 6. Vertical Alignment of Dowels: 1/4 inch .
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 8. Joint Spacing: 3 inches .
 - 9. Contraction Joint Depth: Plus 1/4 inch , no minus.
 - 10. Joint Width: Plus 1/8 inch no minus.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi .
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321316 - DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes colored and stamped concrete paving.
- B. Related Sections:
 - 1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
 - 2. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, stamped detectable warnings, pavement markings, and wheel stops.
 - 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.
- C. Samples for Verification: For each type of exposed color, pattern, or texture indicated.
- D. Other Action Submittals:
 - 1. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and ready-mix concrete manufacturer.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.

3. Admixtures.
4. Applied finish materials.
5. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A company with ten years' experience and an employer of workers trained and approved by manufacturer of decorative concrete paving systems. Contractor to provide three (3) references and color photos of completed work utilizing integrally colored concrete. References of work shall be of similar size, scope, and expected craftsmanship as those shown in the Contract Documents. References shall include project name and address, Owner's or general contractor's name, and current contact information. Concrete Contractor shall be approved by the Owner.
 1. Contractor's field supervisor shall have ten years' experience successfully installing integrally colored concrete. Field supervisor shall be on site at all times when integrally colored concrete is being installed, finished, or in any other way being worked with. Field supervisor's failure to be on site during work with integrally colored concrete shall render the concrete rejected.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm with ten years' successful experience in manufacturing integrally colored, ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Source Limitations: Obtain decorative concrete paving products and each type or class of cementitious material of the same brand from same manufacturer's plant, and obtain each aggregate from single source.
- D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- E. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups at least 6 weeks prior to execution of work to allow for proper curing and sealing. Mockups to be approved by Landscape Architect.
 2. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; sealing; and standard of workmanship.
 3. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 96 inches by 96 inches.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 6. Mockups built elsewhere on the site shall be retained on site the duration of construction. Dispose of mockups upon Landscape Architect's approval.
- G. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 - c. Schedule.
2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Decorative concrete paving Installer.
 - e. Manufacturer's representative of decorative concrete paving system.
3. If representatives are not in attendance of Preinstallation Conference, General Contractor shall reimburse professionals at prevailing billing and travel rates for lost time.

1.7 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 1. Use flexible or uniformly curved forms for curves of a radius of 100 feet or less. Do not use notched and bent forms.
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, gray portland cement Type I/II.
 - a. Fly Ash: Not allowed.
 - b. Ground Granulated Blast-Furnace Slag: Not allowed.
- B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A, colored.
 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D, colored.
 3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

2.4 SURFACE COLORING MATERIALS

- A. Pigmented Powder Release Agent: Factory-packaged, dry combination of surface-conditioning and dispersing agents interground with color pigments that facilitates release of stamp mats. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brickform; a division of Solomon Colors; Antique Release.
 - b. Butterfield Color; Perma-Cast Antiquing Release.
 - c. Scofield, L. M. Company; LITHOCHROME Antiquing Release.
 - d. Approved Equal.

2.5 STAMPING DEVICES

- A. Stamp Mats: Semi-rigid polyurethane mats with projecting textured and ridged underside capable of imprinting texture and joint patterns on plastic concrete.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brickform; a division of Solomon Colors.
 - b. Butterfield Color.
 - c. Scofield, L. M. Company.
 - d. Approved Equal.

2.6 CURING AND SEALING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brickform; a division of Solomon Colors; Evaporation Retarder.
 - b. Dayton Superior; AquaFilm Concentrate J74 or AquaFilm J74RTU.
 - c. Pigment manufacturer's approved product.
- B. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, manufactured for colored concrete.
 - 1. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer.
 - 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
- C. Clear Acrylic Sealer: Manufacturer's standard, waterborne, nonyellowing and UV-resistant, membrane-forming, medium-gloss, acrylic copolymer emulsion solution, manufactured for colored concrete, containing not less than 15 percent solids by volume.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Brickform; a division of Solomon Colors; Setin-Seal.
 - b. H&C Concrete Care Products; Infusion Water-Based Sealer.
 - c. Scofield, L. M. Company; CEMENTONE Clear Sealer.
 - d. Pigment manufacturer's approved product.
- D. Slip-Resistance-Enhancing Additive: Manufacturer's standard finely graded aggregate or polymer additive, designed to be added to clear acrylic sealer to enhance slip resistance of sealed paving surface.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dayton Superior; Grip Aid.
 - b. H&C Concrete Care Products; SharkGrip Slip Resistive Additive.
 - c. Pigment manufacturer's approved product.

2.7 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Pozzolan: Not allowed.
 2. Ground Granulated Blast-Furnace Slag: Not allowed.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below decorative concrete paving to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond rimmed blades. Cut 1/8-inch wide joints into concrete when curing action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement and dowels joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.8 STAMPING

- A. Mat Stamping: After floating and while concrete is plastic, apply mat-stamped finish.
 - 1. Pigmented Powder Release Agent: Uniformly distribute onto concrete at a rate of 3 to 4 lb/100 sq. ft.
 - 2. After application of release agent, accurately align and place stamp mats in sequence.
 - 3. Uniformly load mats and press into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp mats. Hand stamp edges and surfaces unable to be imprinted by stamp mats.
 - 4. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Compound: Apply curing compound immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after application. Maintain continuity of coating, and repair damage during curing period.

3.10 SEALER

- A. Clear Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat using same application methods and rates.
 - 1. Begin sealing dry surface no sooner than 28 days after concrete placement.
 - 2. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch.
4. Lateral Alignment and Spacing of Dowels: 1 inch.
5. Vertical Alignment of Dowels: 1/4 inch.
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

- G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.
- C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.14 DECORATIVE CONCRETE PAVING SCHEDULE

- A. Patterned Decorative Concrete Paving:
 - 1. Locations: Install at walks.
 - 2. Coloring Method: Integrally colored.
 - a. Color: As selected by Landscape Architect from manufacturer's full range.
 - 3. Field Patterning Method: Stamped.
 - a. Texture and Pattern: Cracked Earth.
 - b. Release Agent: To be selected by Landscape Architect from manufacturer's full range.

END OF SECTION 321316

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SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Hot-applied joint sealants.
 - 3. Cold-applied, fuel-resistant joint sealants.
 - 4. Hot-applied, fuel-resistant joint sealants.
 - 5. Joint-sealant backer materials.
 - 6. Primers.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Paving-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonseg, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.
- C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
- D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
- E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I.
- B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.
- C. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.
- D. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type IV.

2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
- B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 12-1/2 or 25, for Use T.

2.5 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D 7116, Type I or Type II.
- B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D 7116, Type III.

2.6 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.7 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of

configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within concrete paving.
1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 2. Joint Sealant: Hot-applied, single-component joint sealant.
 3. Joint-Sealant Color: Black.
- B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving .
1. Joint Location:
 - a. Joints between concrete and asphalt paving.
 - b. Joints between concrete curbs and asphalt paving.
 - c. Other joints as indicated.
 2. Joint Sealant: Hot-applied, single-component joint sealant.
 3. Joint-Sealant Color: Black.
- C. Joint-Sealant Application: Fuel-resistant joints within concrete paving.
1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 2. Joint Sealant: Hot-applied, fuel-resistant, single-component joint sealant.
 3. Joint-Sealant Color: Black.

END OF SECTION 321373

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SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Related Sections:
 - 1. Division 01 "Summary of Work" for limits placed on Contractor's use of the site.
 - 2. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees that interfere with or are affected by execution of work.
 - 3. Section 311000 "Site Clearing" for removal limits of trees, shrubs, and other plantings affected by New Construction.
 - 4. Section 312300 "Excavation and Fill" for excavation, filling and rough grading, and for subsurface aggregate drainage and drainage backfill materials.
 - 5. Section 322200 "Earthmoving" for building and utility trench excavation, backfilling, compacting and grading requirements, and soil materials.
 - 6. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
 - 7. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
 - 8. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

1.3 DESCRIPTION OF WORK

- A. The work required is indicated on the drawings and includes, but is not limited to, the design, installation, and maintenance of lawn and planting area irrigation systems, backflow prevention devices, protective housings, automatic controller(s), rain sensors, remote control valves, quick coupler valves, and water and electric services.
- B. Irrigation system shall be designed as a new system. Connections and zones should be logical in design and appropriate for existing equipment and water service.
 - 1. Contractor shall verify extent of any exiting system prior to start of design for this scope of work.
 - 2. Contractor shall familiarize himself with all existing and proposed conditions including grade differences, location of walls, site features, utilities, and all other site improvements.
- C. Coordinate with Landscape Contractor the placement, type, and water requirements for all plant material.
- D. Areas of underground irrigation system are to include all lawn areas, planting beds, and other disturbed areas as defined in the bid documents. The contractor shall provide the design of the specific system. The system shall be in accordance with the following design criteria:
 - 1. Design of irrigation system shall conform to current industry standards and comply with local and state governing codes.
 - 2. Location of all major components (i.e.: backflow preventer, meter, etc.) shall be coordinated with the owner.

3. All irrigation system(s) shall be designed to minimize vandalism, including lockable protective housings for all equipment installed in location accessible to the public.
4. For each point of connection, submit pressure calculations for the system(s) with the highest psi requirement to operate properly allowing for friction losses within the system. Water velocity within the system shall not exceed 5 fps. In the event pressure differences are not reported prior to start of construction, the irrigation contractor shall assume full responsibility for any revisions necessary.
5. Irrigation system shall be designed for positive winterization. Provide blowouts where positive drainage is not met.
6. Design system(s) to lowest available pressure per local water company's records.
7. All backflow prevention devices must comply with requirements set forth by the local health department and city water department. Prevent any back-siphoning after sectional valves are closed. Backflow prevention devices are not permitted on irrigation systems using reclaimed water.
8. All valves to be in green Ametek boxes, or approved equal.
9. Anti-drain valves in line and/or under sprinkler heads are to be properly installed on sloped irrigation systems to minimize toe of slope sprinkler drainage.
10. Provide construction details for components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Indicate on product data sheets (circle, highlight) which products will be used during the construction of the project. Ensure sheets are scanned and submitted right side up.
- B. Shop Drawings: Submit shop drawings in AutoCAD format, or approved equivalent for underground irrigation system including:
 1. Plan layout and details illustrating:
 - a. Point of connection.
 - b. Location and type of quick couplers.
 - c. Valves.
 - d. Accessories.
 2. Drawings shall be sealed and signed by a Certified Irrigation Designer.
 3. Drawings shall not exceed 1" = 20'.
- C. Substitutions: Submit all desired substitutions for review by the Owner prior to, or simultaneous to, the submittal of the Contractor's bid.
- D. Record Drawings (commonly called 'As Built Drawings'):
 1. Record accurately on one set of contract drawings all changes in the work constituting departures from the original shop drawings. Maintain Record Drawings on site at all times.
 2. The changes and dimensions shall be recorded in a legible and workmanlike manner to the satisfaction of the Landscape Architect. Prior to final inspection of the work, submit Record Drawings.
 3. Dimensions shall be from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavements, etc.). Data to be shown on Record Drawings shall be recorded day-to-day as the project is being installed. All lettering on drawings shall be 1/10-inch in size, minimum.
 4. Show locations and depths of the following items:
 - a. Point of connection.
 - b. Quick coupling valves.
 - c. All related equipment (backflow prevention device(s), controller, rain sensor, etc.).
 5. The following charts, manuals, and equipment shall be turned over to the Owner or Landscape Architect no later than 10 days prior to the final inspection at the end of the maintenance period.

- a. Record Drawings must be approved by the Landscape Architect before controller schedules and charts are prepared.
- 6. All field changes shall be updated in the shop drawings using the same software that created the shop drawings. Record Drawings shall be submitted as a PDF, or approved equal.
- E. Qualification Data: For qualified installer.
- F. Operation and Maintenance Manuals: One digital file as PDF, or approved equal, of operation and maintenance manual shall be delivered to the Landscape Architect ten (10) calendar days prior to final acceptance inspection. The manual shall describe the material installed. The manual shall include the following information:
 - 1. Index sheet stating the Project Name, Contractor's Company Name, contact person, Company address, telephone number, expiration date of the guarantee period, list of equipment including names and addresses of local manufacturer representatives.
 - 2. Complete operating and maintenance instructions for all equipment.
 - 3. Spare parts lists and related product and manufacturer information for all equipment.
- G. Closeout Submittals shall be completed and submitted prior to the issuance of the Final Payment.
- H. Inspection Records: Any inspection that does not pass shall be corrected at the Contractor's expense.
- I. Equipment: Supply as part of this contract the following items:
 - 1. Two (2) valve box cover keys or wrenches.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide underground irrigation system as a complete unit produced by the approved manufacturers including heads, valves, controls, and accessories.
- B. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association and a company having not less than 5 years of experience in the installation of automated irrigation systems using experienced installers who have worked on projects similar in size and scope of the proposed project. Subcontract irrigation work to an experienced, single firm specializing in irrigation design, installation, and operations. Irrigation installer to have state certification. Irrigation Contractor to provide 3 references of work that is of similar size, scope, and expected craftsmanship as those shown in the Contract Documents. References shall include project name and address, owner's or general contractor's name, and current contact information. Irrigation Contractor shall be approved by Owner.
- C. Electrical Components, Devices, and Accessories: Installation shall be by a licensed electrical contractor as required by local and state regulatory requirements to provide a fully operative irrigation system. Electrical contractor shall provide Owner's Representative documentation of inspection and approval of work by all governing regulatory agencies.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
- C. All other components.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.8 WARRANTY

- A. Description: For a period of one (1) year after date of Substantial Completion of work performed under this Contract, Contractor shall promptly furnish and install, without cost to Owner, parts which prove to be defective in material or workmanship.
- B. Shut down and start-up service

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers for irrigation system equipment are:
 - 1. Rain Bird Corporation.
 - 2. The Toro Company (Toro and Irritrol brands).
 - 3. Hunter Industries.
 - 4. Approved Equal.

2.2 MATERIALS AND EQUIPMENT

- A. General requirements:
 - 1. New materials and equipment.
 - 2. PVC pipe, isolation valves, valve boxes, shall all be compatible.

2.3 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: Provide clean, dry, and covered location for storage of all pipe during installation.

2.4 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656. Solvent shall contain pigment.
- B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 AUTOMATIC DRAIN VALVES

- A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.

2.6 MISCELLANEOUS SPECIALTIES

- A. Quick Coupling Swing Joints: Schedule 40 PVC tee and 1-inch swing joint with three 90 degree elbows.

2.7 QUICK COUPLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hunter Industries Incorporated.
2. Rain Bird Corporation.
3. Toro Company (The).
4. Approved Equal.

- B. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).

2.8 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Polymer-Concrete Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Armorcast Products Company.
- b. Carson Industries LLC.
- c. Christy Concrete Products.
- d. NewBasis.
- e. Quazite: Hubbell Power Systems, Inc.
- f. Approved Equal.

2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

- a. Size: As required for valves and service.
- b. Shape: Rectangular.
- c. Sidewall Material: Polymer concrete with lateral and vertical sidewall design loading of 5000 lb minimum over 10 by 10 inches square.
- d. Cover Material: Polymer concrete with cover design loading of 5000 lb. minimum over 10 by 10 inches square.

- 1) Lettering: "IRRIGATION."

- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes provided on shop drawings. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 36 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
 - 2. Drain Piping: 12 inches.
 - 3. Sleeves: 24 inches.

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Landscape Architect's approval before excavation.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Shop Drawings shall indicate location and arrangement of piping systems. Install piping as indicated.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- H. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- I. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- J. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- K. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- L. Install piping in sleeves under parking lots, roadways, and sidewalks.
- M. Install sleeves made of

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 VALVE INSTALLATION

- A. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.6 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221 113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning equipment.
- B. Any irrigation product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that controllers are installed and connected according to the Contract Documents.

3.9 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain valves.

3.11 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes may be joined with flanges or unions instead of joints.

END OF SECTION 328400

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 129300 "Site Furnishings" for placing planting soil in exterior unit planters.
 - 2. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
 - 3. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 4. Section 329300 "Plants" for placing planting soil for plantings.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil, plant, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- H. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- I. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

- J. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- K. SSSA: Soil Science Society of America.
- L. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- M. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- N. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- O. USCC: U.S. Composting Council.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SU1P #25.
 - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.
- B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by one of the following:
 - a. SGS; 1511 E. Main St.; P.O. Box 175; Belleville, IL 62221.
 - b. Local University Extension Soils Testing Laboratory (University of Missouri, University of Illinois, etc.)
 - c. Other certified testing agency.
2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
 1. Notify Landscape Architect seven days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.10 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor under the direction of the testing agency.
 1. Number and Location of Samples: Eleven representative soil samples where indicated on Drawings for each soil to be used or amended for landscaping purposes.
 2. Procedures and Depth of Samples: Per testing laboratory directions.
 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.11 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
- C. Chemical Testing:
 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

2. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
 3. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Do not move or handle materials when they are wet or frozen.
 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
 5. Topsoil and/or planting soil stockpile(s) shall be formed under normal industry standards. Stockpile height shall not exceed highest point of lifting mechanism of equipment (maximum height - 72 inches, 3' wide, 10' long) creating the stockpile. Stockpile will be considered

defective if equipment drives or otherwise compacts stockpile. Do not stockpile within protection zones.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Regional Materials: Imported soil and soil amendments and fertilizers shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the soil amendments and fertilizers in the quantities recommended by the testing agency to produce planting soil.
- C. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of silt loam or silty clay loam soil according to USDA textures; and modified to produce viable planting soil.
 - 1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, Bermuda grass cuttings and/or rhizomes, zoysia grass, and brome grass.
 - 2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
 - 3. Unacceptable Properties: Clean soil of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.
 - 4. Amended Soil Composition: Blend imported, unamended soil with the soil amendments and fertilizers in the quantities recommended by the testing agency to produce planting soil.
- D. Planting-Soil Type: Manufactured bio-filtration soil consisting of manufacturer's basic sandy loam or loamy sand according to the USDA textures, blended with sand, stabilized organic soil amendments and other materials to produce a viable planting and filtration soil.
 - 1. Soil shall be free of stones, stumps, roots, or other woody material over 1 inch in diameter.
 - 2. Soil shall not be sourced from agricultural land, bogs, or marshes; shall not contain undesirable organisms; disease-causing plant pathogens; obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, Bermuda grass cuttings and/or rhizomes, zoysia grass, and brome grass.

3. Additional Properties of Bio-filtration Soil: Soil reaction of 5.2 to 8.0, 35 to 60 percent by volume of sand, \leq 10 percent clay content, friable, and with sufficient structure to give good tilth and aeration.
4. Unacceptable Properties: Bio-filtration soil shall not contain the following:
 - a. Unacceptable materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.
5. Blend Bio-filtration Soil with the following amendments and fertilizers in the following quantities to produce planting soils:
 - a. Permeability: 1.0 feet per day (0.5 inches per hour).
 - b. Organic Matter: 1.5 to 5.0 percent.
 - c. Magnesium: 35 lbs per acre.
 - d. Phosphorus (P_2O_5): 75 lbs per acre.
 - e. Potassium (K_2O): 85 lbs per acre.
 - f. Soluble Salts: \leq 500 ppm.

2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
 3. Form: Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.4 ORGANIC SOIL AMENOMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 1. Feedstock: Limited to leaves, twigs, yard waste, and green food waste.
 2. Reaction: pH of 5.5 to 8.
 3. Soluble-Salt Concentration: Less than 4 dS/m.
 4. Moisture Content: 35 to 55 percent by weight.
 5. Organic-Matter Content: 50 to 60 percent of dry weight.
 6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.5 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth indicated on Drawings, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, except compost, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime or sulfur with dry soil before mixing fertilizer per soil testing recommendations.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments and fertilizer, except compost, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
 1. Mix lime or sulfur with dry soil before mixing fertilizer per soil testing recommendation.
 2. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply compost component of planting-soil mix to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.
 2. Post-installation Soil Test: Provide soil analysis by same laboratory determining pH, CEC, N-P-K, micronutrients, and organic matter.

- C. Soil will be considered defective if it does not pass tests and inspections, or stockpile has not been formed properly per Section 1.
- D. Prepare test and inspection reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Landscape Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Coordinate with owner the legal disposal of excess subsoil and unsuitable materials.

END OF SECTION 329113

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sodding.
 - 2. Meadow grasses and wildflowers.
 - 3. Turf renovation.
- B. Related Requirements:
 - 1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
 - 2. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.

- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
 - 5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod: Certified, Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Legacy Buffalograss (*Buchloe dactyloides* 'Legacy'); Drought tolerant Turf-type Tall Fescue (*Festuca* spp.), minimum of 3 improved cultivars.

2.2 MEADOW GRASSES AND WILDFLOWERS

- A. Wildflower and Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:

1. Slope Stabilization Mix.

Botanical Name	Common Name	PLS Oz/A
Native Grasses		
<i>Bouteloua curtipendula</i>	Side-Oats Grama	48.00
<i>Elymus Canadensis</i>	Canada Wild Rye	32.00
<i>Elymus virginicus</i>	Virginia Wild Rye	24.00
<i>Panicum virgatum</i>	Switchgrass	32.00
<i>Schizachyrium scoparium</i>	Little Bluestem	64.00
Total		200.00
Temporary Cover		
<i>Avena sativa</i>	Common Oat	512.00
<i>Lolium multiflorum</i>	Annual Rye	240.00
Total		752.00
Forbs		
<i>Echinacea purpurea</i>	Purple Coneflower	3.00
<i>Rudbeckia missouriensis</i>	Black-eyed Susans	1.00
Total		4.00

2. Pollinator Native Seed Mix

Botanical Name	Common Name	PLS Oz/A
Native Grasses		
<i>Bouteloua curtipendula</i>	Side-Oats Grama	16.00
<i>Elymus Canadensis</i>	Canada Wild Rye	32.00
<i>Schizachyrium scoparium</i>	Little Bluestem	36.00
<i>Sporobolus heterolepis</i>	Prairie Dropseed	8.00
Total		92.00
Temporary Cover		
<i>Avena sativa</i>	Common Oat	360.00
<i>Lolium multiflorum</i>	Annual Rye	100.00
Total		460.00
Forbs		
<i>Achillea millefolium</i>	Yarrow	0.25
<i>Asclepias tuberosa</i>	Butterfly Milkweed	2.00
<i>Asclepias purpureascens</i>	Purple Milkweed	1.50
<i>Baptisia australis</i>	False Blue Indigo	2.00
<i>Coreopsis lanceolata</i>	Lanceleaf Coreopsis	5.00
<i>Coreopsis palmata</i>	Prairie Coreopsis	1.00
<i>Echinacea pallida</i>	Purple Coneflower	3.00
<i>Echinacea purpurea</i>	Purple Coneflower	7.00
<i>Eryngium yuccifolium</i>	Rattlesnake Master	3.00
<i>Helianthus annuus</i>	False Sunflower	3.00

Monarda fistulosa	Wild Bergamot	0.75
Parthenium integrifolium	Wild Quinine	1.00
Penstemon digitalis	Beardtongue	0.50
Pycnanthemum tenuifolium	Slender Mountain Mint	0.75
Rudbeckia hirta	Black-eyed Susans	5.00
Rudbeckia subtomentosa	Sweet Black-eyed Susans	1.00
Symphotrichum oblongifolium	Aromatic Aster	0.25
Symphotrichum oolentengiense	Skyblue Aster	0.50
	Total	37.50

3. Bird Meadow Native Seed Mix

Botanical Name	Common Name	PLS Oz/A
Native Grasses		
Bouteloua curtipendula	Side-Oats Grama	16.00
Elymus Canadensis	Canada Wild Rye	24.00
Panicum virgatum	Switch Grass	2.50
Schizachyrium scoparium	Little Bluestem	28.00
	Total	70.50
Temporary Cover		
Avena sativa	Common Oat	360.00
Lolium multiflorum	Annual Rye	100.00
	Total	460.00
Forbs		
Aquilegia Canadensis	Wild Columbine	2.00
Asclepias tuberosa	Butterfly Weed	1.50
Coreopsis lanceolata	Sand Coreopsis	5.00
Coreopsis tripteris	Tall Coreopsis	1.50
Echinacea purpurea	Purple Coneflower	8.00
Monarda citriodora	Horsemint	0.25
Phlox paniculata	Garden Phlox	5.00
Rudbeckia hirta	Black-eyed Susans	6.00
Rudbeckia missouriensis	Black-eyed Susans	8.00
Solidago speciose	Showy Goldenrod	1.00
Symphotrichum ericoides	Wreath Aster	0.25
Symphotrichum laeve	Smooth Blue Aster	1.00
	Total	39.50

4. Woodland Restoration Native Seed Mix

Botanical Name	Common Name	PLS Oz/A
Native Grasses		
Andropogon gerardii	Big Bluestem	6.00
Bouteloua curtipendula	Side-Oats Grama	16.00
Carex bicknellii	Copper-shouldered Sedge	1.50
Carex eburnean	Bristle Leaf Sedge	1.50
Elymus canadensis	Canada Wild Rye	24.00
Sporobolus heterolepis	Prairie Dropseed	6.00
	Total	55.00
Temporary Cover		
Avena sativa	Common Oat	360.00
Lolium multiflorum	Annual Rye	100.00
	Total	460.00
Forbs		
Agastache nepetoides	Yellow Giant Hyssop	0.50
Allium cernuum	Nodding Onion	8.00
Anemone virginiana	Tall Anemone	0.50
Aquilegia canadensis	Wild Columbine	1.50
Blephelia ciliate	Ohio Horsemint	0.25
Camassia scilloides	Wild Hyacinth	8.25
Castilleja coccinea	Indian Paintbrush	0.25
Dodecatheon meadia	Shooting Star	1.50

Eupatorium purpureum	Purple Joe-Pye Weed	0.50
Eupatorium sessilifolium	Woodland Boneset	0.50
Helianthus strumosus	Pale-leaved Sunflower	2.00
Heuchera americana	Prairie Alum-root	0.25
Lysimachia quadrifolia	Whorled Loosestrife	0.25
Phlox pilosa	Prairie PHlox	3.00
Polemonium reptans	Jacob's Ladder	0.50
Ranunculus fascicularis	Early Buttercup	2.00
Ratibida pinnata	Yellow Coneflower	2.00
Tephrosia virginiana	Goat's Rue	5.00
Zizia aurea	Golden Alexander	2.00
Total		37.75

- B. Seed Carrier: Inert material, sharp clean sand or perlite.

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
- Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
- Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

- A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
- Organic Matter Content: 50 to 60 percent of dry weight.
 - Feedstock: Agricultural, food, or industrial residuals; yard trimmings; or source-separated or compostable mixed solid waste.

2.5 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect grade stakes set by others until directed to remove them.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.
 - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Landscape Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 TURF RENOVATION

- A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- H. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
 - 1. Soil Amendment(s): Apply soil amendments at the rate specified by the soil testing laboratory recommendations.
 - 2. Initial Fertilizer: Slow-release fertilizer applied according to manufacturer's recommendations.
- I. Apply sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

3.6 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 1. Mow turf-type tall fescue and Bufflao grass to a height of 2 to 3 inches.
- D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.
 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Landscape Architect:
 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.8 MEADOW

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Utilize no-till planters and drills to install seed. Seeding machine shall be specifically designed for the seeding of native grasses and forbs.
 1. Before sowing, mix seed with seed carrier at a ratio of not less than two parts seed carrier to one part seed.
 2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 3. Prior to starting work, all seeding equipment shall be calibrated and adjusted to sow seeds at the proper seed rate. Equipment shall be operated in a manner to ensure complete coverage of entire area to be seeded. Any gaps between areas of growth greater than 5 square feet shall be reseeded and/or replanted.
 4. Do not use wet seed or seed that is moldy or otherwise damaged.
- B. Sow seed at specified above in Part 2.
- C. Brush seed into top 1/16 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.
- E. Water newly planted areas and keep moist until meadow is established.

3.9 MEADOW MAINTENANCE

- A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 2. Water meadow with fine spray at a minimum rate of 1/2 inch per week for eight weeks after planting unless rainfall precipitation is adequate.

3.10 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

3.12 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
1. Sodded Turf: 30 days from date of Substantial Completion.
- B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below.
1. Maintenance Period: 24 months from date of Substantial Completion.

END OF SECTION 329200

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SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Planting soils.
 - 3. Tree stabilization.
 - 4. Landscape edgings.
- B. Related Sections:
 - 1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
 - 2. Section 311000 "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
 - 3. Section 312000 "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 4. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
 - 1. Unit prices apply to authorized work covered by quantity allowances.
 - 2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.4 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

- E. **Container-Grown Stock:** Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. **Duff Layer:** The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- G. **Finish Grade:** Elevation of finished surface of planting soil.
- H. **Manufactured Topsoil:** Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- I. **Pesticide:** A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- J. **Pests:** Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- K. **Planting Area:** Areas to be planted.
- L. **Planting Soil:** Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- M. **Plant; Plants; Plant Material:** These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- N. **Root Flare:** Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- O. **Stem Girdling Roots:** Roots that encircle the stems (trunks) of trees below the soil surface.
- P. **Subgrade:** Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- Q. **Subsoil:** All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- R. **Surface Soil:** Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.5 ACTION SUBMITTALS

- A. **Product Data:** For each type of product indicated, including soils.
 - 1. **Plant Materials:** Include quantities, sizes, quality, and sources for plant materials.
 - 2. **Pesticides and Herbicides:** Include product label and manufacturer's application instructions specific to the Project.
 - 3. **Plant Photographs:** digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Compile photographs for delivery into a single PDF document. Each plant shall utilize one "letter" sized sheet (8.5" x 11") and include the following information:

- a. Color Photograph with multi-colored scale rod or adult
- b. Full Latin and common name of plant.
- c. Size of plant.
- d. Name of growing nursery.
- e. City, State of nursery.

B. - Samples for Verification: For each of the following:

- 1. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
- 2. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified landscape Installer. Provide 3 references of projects similar in size, scope and expected craftsmanship as those shown in the Contract Documents. Include photographs demonstrating Installer's capabilities and experience. Provide project name, address, year completed, and owner's or general contractor's name and current contact information.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Material Test Reports: For existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- E. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Ten years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements." Landscape Contractor shall be approved by Owner.
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with installation, maintenance, or irrigation specialty area(s), designated CLT-Exterior.
 - b. Certified Landscape Technician - Interior, designated CLT-Interior.
 - c. Certified Ornamental Landscape Professional, designated COLP.
 - 5. Pesticide Applicator: State licensed, commercial.

- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
 - C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 - 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 - 3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
 - D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 - E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
 - F. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.
 - G. Preinstallation Conference: Conduct conference at Project site.
- 1.8 DELIVERY, STORAGE, AND HANDLING**
- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
 - B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. Do not remove container-grown stock from containers before time of planting.
 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of each service or utility.
 2. Do not proceed with interruption of services or utilities without Construction Manager's written permission.
- C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 1. Spring Planting: After March 1 for perennials and grasses.
 2. Fall Planting: No later than October 15 for perennials and grasses.
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

- E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
 - 3. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Size: 21-gram tablets.
 - 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.5 PLANTING SOILS

- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 1. Supplement with another specified planting soil when quantities are insufficient.
 - 2. Mix existing, native surface topsoil with the soil amendments and fertilizers in the quantities recommended by the soil testing agency to produce planting soil.
- B. Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the soil amendments and fertilizers in the quantities recommended by the soil testing agency to produce planting soil.
- C. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs, or marshes.
 - 1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
 - 2. Mix imported topsoil or manufactured topsoil with the soil amendments and fertilizers in the quantities recommended by the soil testing agency to produce planting soil.

2.6 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood or ground or shredded bark.
 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 3. Color: Natural.
- B. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:
1. Type: Rounded riverbed gravel or smooth-faced stone.
 2. Size Range: per drawing details.
 3. Color: Uniform tan-beige color range acceptable to Landscape Architect.

2.7 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
 2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
 3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
 4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
 5. Guy Cables: Five-strand, 3/16-inch-diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
 6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.9 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Apply superphosphate fertilizer directly to subgrade before loosening.
 2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 3. Spread planting soil to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Landscape Architect, broadcast dry product uniformly over prepared soil at application rate recommended by manufacturer..

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 1. Excavate approximately three times as wide as ball diameter for balled and burlapped or container-grown stock.
 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected when unattended by installer's personnel.
 8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Subsoil and topsoil removed from excavations may be used as planting soil.
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow percolating away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 1. Use planting soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
1. Use planting soil for backfill.
 2. Carefully remove root ball from container without damaging root ball or plant.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
 1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 2. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Staking and Guying: Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.
 1. Site-Fabricated Staking-and-Guying Method:
 - a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
 - b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 - d. Attach flags to each guy wire, 30 inches above finish grade.
 - e. Paint turnbuckles with luminescent white paint.

3.8 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 2-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.
 - 3. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 EDGING INSTALLATION

- A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch deep, shovel-cut edge as shown on Drawings.

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Pressure pipe couplings.
 - 4. Expansion joints and deflection fittings.
 - 5. Cleanouts.
 - 6. Manholes.
 - 7. Catch basins.
 - 8. Pipe outlets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
 - 2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
 - 3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- D. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.
 - 1. Special-Joint Bands: Corrugated steel with O-ring seals.
 - 2. Standard-Joint Bands: Corrugated steel.
 - 3. Coating: Zinc.

2.2 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
 - 2. Silttight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
 - 2. Silttight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.3 PVC PIPE AND FITTINGS

- A. PVC Cellular-Core Piping:
 - 1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 - 2. Fittings: ASTM D 3034, SDR 26, PVC socket-type fittings.
- B. PVC Corrugated Sewer Piping:
 - 1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
 - 3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900, Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 150 PVC pipe with bell ends
3. Gaskets: ASTM F 477, elastomeric seals.

G. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, Schedule 40 and Schedule 80 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 2466, Schedule 40 and ASTM D 2467, Schedule 80 PVC, socket type.

2.4 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Tongue-and-groove ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant
2. Class III, 12 to 24 inch (300 to 600 mm) diameter Wall B,
30 to 60 inch (750 to 1500 mm) diameter Wall C.
3. Class IV, 12 to 24 inch (300 to 600 mm) diameter Wall B,
30 to 60 inch (750 to 1500 mm) diameter Wall C.
4. Class V, 12 to 24 inch (300 to 600 mm) diameter Wall B,
30 to 60 inch (750 to 1500 mm) diameter Wall C.

2.5 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
10. Adjusting Rings: Interlocking HOPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.7 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
8. Steps: ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches (1500 mm).
9. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.

B. Beehive Grates and Frames: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Size and style as indicated on drawings.

C. Domed Grates: Domed grates shall be cast or ductile iron and shall be made specifically for each fitting. Grates for 12 inches (300 mm) and larger drain basins and inline drains shall be capable of

supporting H-10 wheel loading for pedestrian grates and H-20 wheel loading for standard grates and solid covers. Metal used in the manufacture of the castings shall conform to ASTM A-48-83 Class 30B for cast iron or A536 Grade 70-50-05 for ductile iron. The castings shall be furnished with a black paint.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping to lines and grades as indicated on drawings.
 - 3. Install corrugated steel piping according to ASTM A 798/A 798M.
 - 4. Install PE corrugated sewer piping according to ASTM D 2321.
 - 5. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 7. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 8. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.
 - 9. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- G. Install force-main pressure piping according to the following:
 - 1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
 - 2. Install piping with 48-inch (1220-mm) minimum cover.
 - 3. Install PVC pressure piping according to AWWA M23, or ASTM D 2774 and ASTM F 1668.
 - 4. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
 2. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
 3. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
 4. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
 5. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 6. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 7. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 8. Join dissimilar pipe materials with nonpressure-type flexible couplings.
- B. Join force-main pressure piping according to the following:
1. Join PVC pressure piping according to AWWA M23 for gasketed joints.
 2. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.
 3. Join dissimilar pipe materials with pressure-type couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 12 by 12 by 4 inches (300 by 300 by 100 mm) deep. Set with tops flush with surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches (50 mm) above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct riprap of broken stone, as indicated.

- B. Install outlets that spill onto grade, anchored with concrete, where indicated.
- C. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- D. Construct energy dissipaters at outlets, as indicated.

3.8 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.

3.9 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

- C. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICATION

- A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UN-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (1035 kPa).
 - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100

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SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Perforated-wall pipe and fittings.
 - 2. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.
 - a.

2.2 SOIL MATERIALS

- A. Soil materials are specified in Section 312000 "Earth Moving."

2.3 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.
 - 1. Survivability: AASHTO M 288 Class 2.
 - 2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.3 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).
- D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches (150 mm) between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.
- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches (300 mm) of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).
- I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Fill to finish grade.

3.4 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
 - 1. Landscaping Subdrainage: Install piping pitched down in direction of flow matching lines and grades as indicated on drawings.
 - 2. Lay perforated pipe with perforations down.
 - 3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

3.5 PIPE JOINT CONSTRUCTION

- A. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.

3.6 CONNECTIONS

- A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.7 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."
 - 1. Install PE warning tape or detectable warning tape over ferrous piping.
 - 2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
 - 2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- B. Drain piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

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PROJECT MANUAL
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SHEPHERD OF THE HILLS FISH HATCHERY

CONSERVATION CENTER REPLACEMENT

PROJECT JOB NUMBER: 56-01-71

AND

STORAGE BUILDING IMPROVEMENTS

PROJECT JOB NUMBER: 56-01-64

TANEY COUNTY, MISSOURI

Designed by: Missouri Department of Conservation
Design and Development

Bid Date: January 26, 2017

**MISSOURI DEPARTMENT OF CONSERVATION
DESIGN AND DEVELOPMENT
2901 WEST TRUMAN BLVD., PO BOX 180
JEFFERSON CITY, MISSOURI 65102**



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SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Demolition and removal of buildings and site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and abandoning in-place and/or removing site utilities as designated on the Drawings.

- B. Related Sections include the following:

1. Division 01 Section "Summary" for use of the premises and phasing requirements.
2. Division 01 Section "Temporary Facilities and Controls" for temporary construction, protection facilities, and environmental-protection measures for building demolition operations.
3. Division 22 Sections for demolishing or relocating site plumbing items.
4. Division 26 Sections for demolishing or relocating site electrical items.
5. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 SUBMITTALS

- A. Schedule of Building Demolition Activities: Indicate the following:
 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 2. Temporary interruption of utility services.
 3. Shutoff and capping or re-routing of utility services.

- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes. The Contractor shall provide asbestos waste manifest documentation to the Owner upon completion of the work.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to Missouri Department of Natural Resources (MDNR) and EPA regulations. Include name and address of technician and date refrigerant was recovered.
- D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by structure demolition operations.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing MDNR and EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.7 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Owner assumes no responsibility for buildings and structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 2. Before building demolition, Owner will remove the following items:
 - a. List will be provided as part of the addendum issued after the pre-bid meeting.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Project Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract or under a negotiated change order with the Contractor.
- D. Asbestos: Asbestos, material containing asbestos, and asbestos impacted materials shall be handled in accordance with the following specifications/tasks:
 - 1. Refer to Division 00 Section "Asbestos Inspection Report" prepared by Sunbelt Environmental Services, Inc. for the asbestos analysis of bulk materials.
 - 2. Notify the EPA at least 10 working days prior to demolition per 40 CFR 61.
 - 3. Prepare and submit Asbestos Abatement for the Owner's review and approval per the guidelines published by the National Institute of Building Sciences (NISB), Asbestos Abatement and Management in Buildings – Model Guide Specifications.
 - 4. Demolish part of the building containing asbestos materials per 29 CFR 1926.1101.
 - 5. Remove and legally dispose of the asbestos containing materials in an EPA approved asbestos landfill.
- E. On-site storage or sale of removed items or materials is not permitted.

1.8 COORDINATION

- A. Arrange demolition schedule so as not to interfere with work in other phases.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Division 31 Section "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.
- B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. The Contractor and the Owner shall coordinate to arrange for the shut off or transfer of the services for the Owner's indicated utilities within a week after the Notice to Proceed has been issued to the Contractor to allow the Contractor time to coordinate any needed change over in services. The Contractor shall be responsible for reimbursing the Owner for any substantial use or waste of the services during this period.
 - 2. Refer to Divisions 22 and 26 Sections for more specific requirements for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.

3.3 PROTECTION

- A. Existing Facilities: Protect adjacent features to remain during demolition operations.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."
 - 1. Protect adjacent property and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.
- 3.4 DEMOLITION, GENERAL
- A. General: Demolish indicated existing buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain adequate ventilation when using cutting torches.
 - 3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
 - C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 3.5 DEMOLITION BY MECHANICAL MEANS
- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
 - C. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, completely, or as directed by the project engineer.
 - 2. Separate soil material from below-grade structure improvements to be removed.

- D. Existing Utilities: Abandon existing utilities as indicated on the Drawings. Cut and cap utilities that are greater than or equal to two (2) feet below the indicated finish grades. Demolish and remove abandoned utilities that are less than eighteen (18) inches of indicated finish grades.
- E. Existing Utilities Structures: Demolish and remove existing below-grade utility structures as indicated on the Drawings.
 - 1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 - 2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.6 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.
- C. Coordination: Coordinate site restoration grading and earthwork with Section 312000 Earth Moving.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them in an MDNR - approved landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

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SECTION 024120 - WATER SUPPLY WELL ABANDONMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Water supply wells Abandonment.

1.2 DEFINITIONS

- A. Water Well Abandonment Includes abandoning existing well, appurtenances, including pump, piping, casing to 36" below ground surface and concrete slab.

1.3 SUBMITTALS

- A. The Contractor shall provide the following:
 - 1. Submit registration report form and any applicable fees to the Department of Natural Resources (DNR), Wellhead Protection Section.
 - 2. Well Abandonment Registration Record.
 - 3. Digital picture of abandoned well site, before and after.

1.4 WELL ABANDONMENT

- A. Contractor must be a permitted well or pump installation contractor.
- B. Comply with AWWA A100 when abandoning water supply wells. Fill and seal holes and casings, remove casing to 36" below final ground level, remove any items in the well, any well slab, and grade the ground surface to finished grade.
- C. Follow well-abandonment regulation of the EPA and MDNR Regulations 10 CSR 23-3.110 Plugging of Wells. Restore ground surface to finished grade.

PART 2 - PRODUCTS

- A. Neat Cement: A mixture of one 94 lb. of Portland Type I cement mixed with 5 ½ to 6 gallons of clean water. No sand or gravel is permitted to be added.
- B. Fill Material: Gravel, sand, varied sized agricultural lime or other approved material.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Well Data
 - 1. Contractor shall obtain available well data from Missouri Department of Natural Resources (MDNR) Division of Geology and Land Survey or local authority having jurisdiction for maintaining well data and records or obtain the necessary data from field measurements needed for proper legal abandonment and plugging of existing wells.

3.2 ABANDONMENT

- A. Contractor shall contact the Division of Geology and Land Survey, Wellhead Protection Section (Phone: 573-368-2170) at least 72 hours before plugging occurs to provide adequate notification for witnessing plugging operations.
- B. Remove and dispose of any appurtenances in the well.
- C. Remove and dispose of well house slab.
- D. Remove and dispose of well casing to a minimum of 36" below ground surface.
- E. Abandon well as per AWWA100, MDNR specifications10 CSR 23-3.110 Plugging of Wells and EPA requirements and to the following depths.
 - 1. Plug well full length with neat cement grout introduced through a tremie pipe.
- F. Dispose of all materials at a recycling center or a legal land fill.
- G. A report of the method of plugging shall be filed with the MDNR on a registration report form that is provided by the MDNR. Registration form must be submitted within 60 days after plugging of each well.
- H. Furnish well abandonment log and a digital picture of the abandoned well site to the Owner.

END OF SECTION 024120

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings/Pipe embedment.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Concrete toppings.
 - 5. Concrete pavements and sidewalks
- B. Related Sections include the following:
 - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Curing compounds.

- F. Field quality-control test and inspection reports.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** A qualified installer who employs on project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Testing Agency Qualifications:** An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. **Concrete Testing Service:** Owner will engage a qualified independent testing agency to perform material evaluation tests.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. **Steel Reinforcement:** Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. **Available Products:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. **Products:** Subject to compliance with requirements, provide one of the products specified.
 - 3. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M, deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type IA, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Available Products:
 - a. Fortifiber Corporation; Moistop Ultra A.
 - b. Raven Industries Inc.; Vapor Block 10.
 - c. Reef Industries, Inc.; Griffolyn Type-65G
 - d. Or Equal

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Available Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edoco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
- e. Dayton Superior Corporation; Sure Film.
- f. Euclid Chemical Company (The); Eucobar.
- g. Kaufman Products, Inc.; Vapor Aid.
- h. Lambert Corporation; Lambco Skin.
- i. L&M Construction Chemicals, Inc.; E-Con.
- j. MBT Protection and Repair, Div. of ChemRex; Confilm.
- k. Meadows, W. R., Inc.; Sealtight Evapre.
- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- n. Sika Corporation, Inc.; SikaFilm.
- o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
- p. Unitex; Pro-Film.
- q. US Mix Products Company; US Spec Monofilm ER.
- r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- s. Or Equal

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Available Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. Burke by Edoco; Aqua Resin Cure.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
- f. Euclid Chemical Company (The); Kurez DR VOX.
- g. Kaufman Products, Inc.; Thinfilm 420.
- h. Lambert Corporation; Aqua Kure-Clear.
- i. L&M Construction Chemicals, Inc.; L&M Cure R.
- j. Meadows, W. R., Inc.; 1100 Clear.
- k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
- l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
- m. Tamms Industries, Inc.; Hornocure WB 30.
- n. Unitex; Hydro Cure 309.
- o. US Mix Products Company; US Spec Maxcure Resin Clear.
- p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- q. Or Equal.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Available Products:

- a. Anti-Hydro International, Inc.; AH Clear Cure WB.
- b. Burke by Edoco; Spartan Cote WB II.
- c. ChemMasters; Safe-Cure & Seal 20.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
- e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
- f. Euclid Chemical Company (The); Aqua Cure VOX.
- g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
- h. Lambert Corporation; Glazecote Sealer-20.
- i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
- j. Meadows, W. R., Inc.; Vocomp-20.
- k. Metalcrete Industries; Metcure.
- l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
- m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- n. Tamms Industries, Inc.; Clearseal WB 150.
- o. Unitex; Hydro Seal.
- p. US Mix Products Company; US Spec Hydrasheen 15 percent
- q. Vexcon Chemicals, Inc.; Starseal 309.
- r. Or Equal

- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Available Products:

- a. Burke by Edoco; Cureseal 1315.
- b. ChemMasters; Spray-Cure & Seal Plus.
- c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315.
- d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
- e. Euclid Chemical Company (The); Super Diamond Clear.
- f. Kaufman Products, Inc.; Sure Cure 25.
- g. Lambert Corporation; UV Super Seal.
- h. L&M Construction Chemicals, Inc.; Lumiseal Plus.
- i. Meadows, W. R., Inc.; CS-309/30.
- j. Metalcrete Industries; Seal N Kure 0.
- k. Sonneborn, Div. of ChemRex; Kure-N-Seal 5.
- l. Tamms Industries, Inc.; LusterSeal 300.
- m. Unitex; Solvent Seal 1315.
- n. US Mix Products Company; US Spec CS-25
- o. Vexcon Chemicals, Inc.; Certi-Vex AC 1315
- p. Or Equal

- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Available Products:

- a. Burke by Edoco; Cureseal 1315 WB.
- b. ChemMasters; Polyseal WB.
- c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
- d. Euclid Chemical Company (The); Super Diamond Clear VOX.
- e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.

- f. Lambert Corporation; UV Safe Seal.
- g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
- h. Meadows, W. R., Inc.; Vocomp-30.
- i. Metalcrete Industries; Metcure 30.
- j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
- k. Tamms Industries, Inc.; LusterSeal WB 300.
- l. Unitex; Hydro Seal 25.
- m. US Mix Products Company; US Spec Radiance UV-25.
- n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
- o. Or Equal

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 20 percent.

2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- 2.12 CONCRETE MIXTURES
- A. Slurry Concrete for Riprap, Footings, Foundation Walls, Slabs on Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 5-1/2 percent, plus or minus 1 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: 6 percent, plus or minus 1 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.
- B. Pipe Embedment Concrete/Concrete Backfill (See Detail 1 and 3, sheet M-504): Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 5-1/2 percent, plus or minus 1 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: 6 percent, plus or minus 1 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.
- C. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
- 2.13 FABRICATING REINFORCEMENT
- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair vapor retarders according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. E-Doweled joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Flatwork: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. ("Soft-Cut" usually within 4 hours of placing concrete.)
- D. Isolation Joints: After removing formwork, install joint-filler strips at junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
 - E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- 3.8 CONCRETE PLACEMENT
- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
 - B. The slump may be adjusted to the required value by adding water up to the amount allowed in the accepted mixture proportions. Do not add water to concrete delivered in equipment not acceptable for mixing. After plasticizing or high-range water-reducing admixtures are added to the concrete at the site to achieve flow able concrete, do not add water to the concrete. Measure slump and air content of air-entrained concrete after slump adjustment to verify compliance with specified requirements.
 - C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 - D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
 - E. Deposit and consolidate concrete for flatwork in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Scream slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 - F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS, SLABS AND FLATWORK

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch.
- C. Broom Finish: Apply a broom finish to exterior concrete flatwork platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

- c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
- 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
- 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner may engage a qualified independent testing and inspecting agency to perform field tests and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this article.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

- b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
- 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- 10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
- 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 033000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Shelf angles.
4. Loose bearing and leveling plates for applications where they are not specified in other Sections
5. Beam brackets /hangers.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.3 SUBMITTALS

- A. Product Data: For all products of this section as requested.

- B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

- C. Welding certificates.

- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

- B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Wood Screws: Flat head, ASME B18.6.1.
- G. Plain Washers: Round, ASME B18.22.1.

- H. Lock Washers: Helical, spring type, ASME B18.21.1.
- I. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- J. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- K. Post-Installed Anchors: chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations Stainless Steel: Alloy Group 1 or Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 9 painting Sections.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 4000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Galvanize miscellaneous framing and supports where indicated.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

- 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

- C. Galvanize exterior miscellaneous steel trim.

- D. Prime exterior miscellaneous steel trim with zinc-rich primer. primer specified in Division 9 Section "Exterior Painting."

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

- B. Galvanize plates.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.

- C. Galvanize loose steel lintels located in exterior walls.

2.11 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Finish metal fabrications after assembly.

- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.

- 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders and beams on solid grouted masonry, concrete, or steel pipe columns. Secure girders and beams with anchor bolts embedded in grouted masonry or concrete.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Framing with dimension lumber.
 - 2. Framing with engineered wood products.
 - 3. Wood blocking, cants, and nailers.
 - 4. Wood furring and grounds.
 - 5. Plywood backing panels.
 - 6. Bolts, screws, nails and other fasteners used for framing.
 - 7. Metal framing connectors.
- B. Related Sections include the following:
 - 1. Division 6 Section "Structural Insulated Panels"

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Exposed Framing: Dimension lumber not concealed by other construction. See other sections for finish requirements.
- C. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches.
- D. Timber: Lumber of 5 inches nominal or greater in least dimension.
- E. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Also indicate any chemical treatment manufacturer recommendations for corrosion resistance of fasteners and connectors used in contact with treated wood.

2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.
- C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preserved-treated wood.
 2. Engineered wood products.
 3. Power-driven fasteners.
 4. Powder-actuated fasteners.
 5. Expansion anchors.
 6. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Engineered Wood Products: Provide engineered wood products for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPAC2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Code approved.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
 - 3. Pressure treat items to the minimum retention as recommended by the manufacturer for the particular installation.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat as indicated on the Drawings and as follows:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. General: Unless indicated otherwise on the Plans, provide dimension lumber of the following grades and species indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Maximum Moisture Content: 19 percent.
- C. Non-Load-Bearing Interior Partitions: No. 2 grade or better and any of the following species:
 - 1. Mixed southern pine; SPIB.
 - 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
 - 4. Eastern softwoods; NELMA.
 - 5. Northern species; NLGA.
 - 6. Western woods; WCLIB or WWPA.
- D. Exterior and Load-Bearing Walls and Other Framing Besides Non-Load-Bearing Partitions: No. 2 grade or better and any of the following species:
 - 1. Douglas fir-larch; WCLIB or WWPA.
 - 2. Southern pine; SPIB.
- E. Ceiling Joists (Non-Load-Bearing): No. 2 grade or better and any of the following species:

1. Douglas fir-larch; WCLIB or WWPA.
2. Southern pine; SPIB.

F. Joists, Rafters, and Other Framing Not Listed Above (Check plans to see if grade is specified.): No. 1 grade or better and any of the following species:

1. Douglas fir-larch; WCLIB or WWPA.
2. Southern pine; SPIB.

2.4 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:

1. Rooftop equipment bases and support curbs.
2. Blocking.
3. Nailers.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.
2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; NELMA.
5. Northern species; NLGA.
6. Western woods; WCLIB or WWPA.

C. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Finish or 1 Common (Colonial) grade; NELMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine, C & Btr Finish grade; SPIB.
3. Hem-fir or Hem-fir (north), Superior or C & Btr Finish grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or Spruce-pine-fir, 1 Common grade; NELMA, NLGA, WCLIB, or WWPA.
5. Western red cedar, A grade; NLGA or WWPA.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or Hem-fir (north), 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or Spruce-pine-fir, 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, No. 2 Common grade; WCLIB or WWPA.

2.5 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, public view, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel. Comply with chemical treatment manufacturer recommendations for corrosion resistance of fasteners and connectors used in contact with treated wood.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 METAL FRAMING ANCHORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following or approved equal.
 - 1. Alpine Engineered Products, Inc.
 - 2. Cleveland Steel Specialty Co.
 - 3. Harlen Metal Products, Inc.
 - 4. KC Metals Products, Inc.
 - 5. Simpson Strong-Tie Co., Inc.
 - 6. Southeastern Metals Manufacturing Co., Inc.
 - 7. USP Structural Connectors.
- C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated or of the basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- D. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations where stainless steel is not indicated or other locations as required.

E. Stainless-Steel Sheet: ASTM A 666, Type 304 or 316.

1. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

2.9 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- E. Do not splice structural members between supports, unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities.
- H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- K. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

- L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.

2.10 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

2.11 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs. Fasten plates to supporting construction, unless otherwise indicated.
 - 1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated on drawings. Provide sill-sealer gasket at all exterior walls.

END OF SECTION 061000

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof Sheathing.
 - 2. Wall Sheathing.
- B. Related Sections include the following:
 - 1. Division 06 Section "Rough Carpentry"

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 QUALITY ASSURANCE

- A. APA exterior structural rated sheathing
 - 1. Plywood.
 - 2. Oriented strand board.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 ROOF, CEILING and WALL SHEATHING

- A. Plywood Roof /Ceiling Sheathing: Exposure 1, APA Rated Structural sheathing.
 - 1. Span Rating: Not less than 40/20.
 - 2. Nominal Thickness: Not less than 5/8 inch.
- B. Oriented-Strand-Board Roof/Ceiling Sheathing: Exposure 1, APA Rated Structural sheathing.
 - 1. Span Rating: Not less than 40/20
 - 2. Nominal Thickness: Not less than 5/8 inch.
- C. Plywood Wall Sheathing: Exposure 1, APA Rated Structural sheathing.
 - 1. Span Rating: Not less than 32/16.

2. Nominal Thickness: Not less than 1/2 inch.
- D. Oriented-Strand-Board Wall Sheathing: Exposure 1, APA Rated Structural sheathing .
 1. Span Rating: Not less than 32/16
 2. Nominal Thickness: Not less than 1/2 inch.

2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Edge spacer clips: Installed as recommended by sheathing manufacturer.

2.3 WEATHER-RESISTANT SHEATHING PAPER

- A. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
 - b. DuPont Tyvek HomeWrap and HeaderWrap.
 - c. Ludlow Coated Products; Air Stop Housewrap.
 3. Water-Vapor Permeance: Not less than **125** through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
 4. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with damage or defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday.
- G. Stagger the joints of sheathing.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.

3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

- A. General: Cover sheathing with weather-resistant sheathing paper as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.
- B. Building Wrap: Comply with manufacturer's written instructions.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

END OF SECTION 061600

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SECTION 061760 - METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes wood roof trusses and truss accessories.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for dimensional and engineered lumber, for supplementary framing and permanent bracing.
 - 2. Division 6 Section "Sheathing" for roof and wall sheathing.

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.
- B. TPI: Truss Plate Institute, Inc.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NLGA - National Lumber Grades Authority.
 - 3. SPIB - Southern Pine Inspection Bureau.
 - 4. WCLIB - West Coast Lumber Inspection Bureau.
 - 5. WWPAA - Western Wood Products Association.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - a. Roof Live Load (Snow Load): 25 psf. min. and per ICC International Building Code for project location.
 - b. Lower Chord Live Load: 10 psf.
 - c. Dead Load Top Chord: 10 psf
 - d. Dead Load Bottom Chord: 10 psf
 - 2. Maximum Deflection Under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/240 of span.

1.5 SUBMITTALS

- A. Product Data: For metal-plate connectors, metal framing anchors, bolts, and fasteners.

- B. **Sealed Shop Drawings:** Show location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber; splice details; type, size, material, finish, design values, orientation, and location of metal connector plates; and bearing details.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. **Product Certificates:** For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.
- D. **Qualification Data:** For professional engineer.
- E. **Material Certificates:** For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.

1.6 QUALITY ASSURANCE

- A. **Metal Connector-Plate Manufacturer Qualifications:** A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in TPI 1.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer licensed in Missouri.
- B. **Fabricator Qualifications:** Shop that participates in a recognized quality-assurance program that involves inspection by SPIB, Timber Products Inspection, TPI, or other independent testing and inspecting agency acceptable to engineer and authorities having jurisdiction.
- C. **Source Limitations for Connector Plates:** Obtain metal connector plates through one source from a single manufacturer.
- D. **Comply with applicable requirements and recommendations of the following publications:**
 - 1. TP1 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
 - 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
 - 3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."
- E. **Wood Structural Design Standard:** Comply with applicable requirements in AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. **Comply with TPI recommendations to avoid damage and lateral bending.** Provide for air circulation around stacks and under coverings.
- B. **Inspect trusses showing discoloration, corrosion, or other evidence of deterioration.** Discard and replace trusses that are damaged or defective.

1.8 COORDINATION

- A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Metal Connector Plates:
 - a. Alpine Engineered Products, Inc.
 - b. CompuTrus, Inc.
 - c. Eagle Metal Products.
 - d. Jager Industries, Inc.
 - e. Mitek Industries, Inc.
 - f. Robbins Engineering, Inc.
 - g. TEE-LOK Corporation.
 - h. Truswal Systems Corporation.
 - 2. Metal Framing Anchors:
 - a. Alpine Engineered Products, Inc.
 - b. KC Metals Products, Inc.
 - c. Simpson Strong-Tie Company, Inc.
 - d. United Steel Products Company, Inc.

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber in the classroom to receive natural or stained finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S, manufactured to actual sizes required by DOC PS 20 for moisture content specified.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Grade and Species: Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specifications for Wood Construction" and its "Supplement."
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 6 Section "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates to comply with TPI 1 from metal complying with requirements indicated below:
- B. Hot-Dip Galvanized Steel Sheet: ASTM A 653, G60 coating designation; Designation SS, Grade 33, and not less than 0.036 inch thick.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners [with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Wire, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.6 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.

- B. Before installing, splice trusses delivered to Project site in more than one piece.
 - C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
 - D. Install and brace trusses according to TPI recommendations and as indicated.
 - E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
 - F. Space trusses 24 inches o.c; adjust and align trusses in location before permanently fastening.
 - G. Anchor trusses securely at bearing points; use metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.
 - H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
 - I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
 - J. Install wood trusses within installation tolerances in TPI 1.
 - K. Do not cut or remove truss members.
 - L. Replace wood trusses that are damaged or do not meet requirements.
 - 1. Do not alter trusses in field.
- 3.2 REPAIRS AND PROTECTION
- A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
 - B. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 061760

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SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior wood and wood trim.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for framing, furring, blocking, and other carpentry work.
 - 2. Section 061600 "Sheathing" for weather resistant and exterior sheathing.

1.3 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
 - 3. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.
- B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- C. Compliance Certificates:
 - 1. For lumber that is not marked with grade stamp.
 - 2. For preservative-treated wood that is not marked with treatment-quality mark.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
 - 1. For exterior wood columns, comply with manufacturer's written instructions and warranty requirements.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and the following grading rules:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
 - 2. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
 - 3. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
 - 4. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
 - 5. WWP: Western Wood Products Association, "Western Lumber Grading Rules."
- B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP U1; Use Category UC3b.
 - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent respectively.
 - 2. Preservative Chemicals: Acceptable to authorities having jurisdiction.
 - 3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.

4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.
 - a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
 - a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
7. Application: All exterior lumber and plywood including lumber and plywood.

2.3 EXTERIOR TRIM

A. Lumber Trim for Semitransparent-Stained Finish and Clear Finish or unfinished:

1. Species and Grade: Western red cedar, Clear Heart Grade A; NLGA, WCLIB, or WWPA.
2. Species and Grade: Hem-fir, pressure-preservative treated; Prime, 1 Common, NLGA, WCLIB, or WWPA.
3. Species and Grade: Southern pine, pressure-preservative treated; B & C & Btr; SPIB.
4. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
5. Face Surface: Surfaced (smooth) textured.

B. Lumber Trim for Opaque-Stained Finish:

1. Species and Grade: Hem-fir, Prime, 1 Common; NLGA, WCLIB, or WWPA.
2. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For pressure-preservative-treated wood, provide stainless-steel or hot-dip galvanized-steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

D. Sealants: Latex, complying with ASTM C 834 Type OP, Grade NF and with applicable requirements in Section "Joint Sealants," recommended by sealant manufacturer and manufacturer of substrates for intended application.

2.5 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches except members with ends exposed in finished work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section "Exterior Painting."

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 3. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
 - 4. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.
 - 5. Apply clear latex sealant to all exposed exterior wood work upon completion of installation.

3.4 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.5 CLEANING

- A. Clean exterior finish carpentry on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.6 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

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SECTION 064020 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Plastic-laminate cabinets.
 - 3. Plastic-laminate countertops.
 - 4. Closet and utility shelving.
 - 5. Shop finishing of interior woodwork.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 6 Section "Rough Carpentry."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware, accessories, finishing materials and processes.
- B. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate cabinet hardware and accessories and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 - 3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

4. Apply WI-certified compliance label to first page of Shop Drawings.

D. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.
3. Plastic laminates.
4. PVC edge material.
5. Thermoset decorative panels.
6. Solid-surfacing materials.

E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

F. Qualification Data: For Installer fabricator.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork and transparent-finished wood doors that are required to be of same species as woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule as selected by owner to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:
- B. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced.
- C. Wood Species for Opaque Finish: Any closed-grain hardwood
- D. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 4. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 5. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- E. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Abet Laminati, Inc.
 - b. Arborite; Division of ITW Canada, Inc.
 - c. Formica Corporation.
 - d. Lamin-Art, Inc.
 - e. Nevamar Company, LLC; Decorative Products Div.
 - f. Panolam Industries International Incorporated.
 - g. Westinghouse Electric Corp.; Specialty Products Div.
 - h. Wilsonart International; Div. of Premark International, Inc.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening.
- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- G. Drawer Slides: BHMA A156.9, B05091.
1. Standard Duty (Grade 1): Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.

2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches high and 24 inches wide.
 3. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches high and 24 inches wide.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.
- J. Grommets for Cable Passage through Countertops: 1-1/4-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- 2.4 MISCELLANEOUS MATERIALS
- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement Contact cement PVA Resorcinol.
1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 2.5 FABRICATION, GENERAL
- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
 - F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.
- 2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH
- A. Grade: Custom.
 - B. Wood Species and Cut: Red oak, plain sawn
 1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
 - C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
 - D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
 - E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 - F. Assemble casings in plant except where limitations of access to place of installation require field assembly.
 - G. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.
- 2.7 PLASTIC-LAMINATE CABINETS
- A. Grade: Custom.
 - B. AWI Type of Cabinet Construction: Flush overlay.
 - C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 1. Horizontal Surfaces Other Than Tops: Grade HGL.
 2. Postformed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.

4. Edges: Grade HGS, Grade VGS, matching laminate in color, pattern, and finish.
- D. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish PVC T-mold matching laminate in color, pattern, and finish PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS CLS.
 2. Drawer Sides and Backs: Thermoset decorative panels.
 3. Drawer Bottoms: Thermoset decorative panels.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Wood grains, gloss matte finish.
 - c. Patterns, gloss matte finish.
- G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- 2.8 PLASTIC-LAMINATE COUNTERTOPS
- A. Grade: Custom.
- B. High-Pressure Decorative Laminate Grade: HGP.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Wood grains, gloss matte finish.
 - c. Patterns, gloss matte finish.
- D. Grain Direction: Parallel to cabinet fronts.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces
- F. Core Material: Particleboard or medium-density fiberboard
- G. Core Material at Sinks: exterior-grade plywood.
- H. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.
- I. Paper Backing: Provide paper backing on underside of countertop substrate.

2.9 CLOSET AND UTILITY SHELVING

- A. Grade: Economy.
- B. Shelf Material: 3/4-inch solid lumber.
- C. Cleats: 3/4-inch solid lumber.
- D. Wood Species: Any closed-grain hardwood

2.10 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.
- D. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 9 painting Sections for finishing architectural woodwork not indicated to be shop finished.
- E. Shop Priming: Shop apply the prime coat including backpriming; if any, for transparent-finished items specified to be field finished. Refer to Division 9 painting Sections for material and application requirements.
- F. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- G. Transparent Finish:
 - 1. Grade: Premium Custom Economy.
 - 2. AWI Finish System: Acrylic lacquer.
 - 3. AWI Finish System: Catalyzed polyurethane.
 - 4. Staining: Match approved sample for color.
 - 5. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 6. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply wash-coat sealer after staining and before filling.
 - 7. Sheen: Flat, 15-30 Satin, 31-45 Semigloss, 46-60 Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D 523.

H. Opaque Finish:

1. Grade: Premium Custom Economy.
2. AWI Finish System: Acrylic lacquer.
3. AWI Finish System: Catalyzed polyurethane.
4. Color: As selected by Architect from manufacturer's full range.
5. Sheen: Flat, 15-30 Satin, 31-45 Semigloss, 46-60 Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches 60 inches 96 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

- H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of cabinets with transparent finish.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064020

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
- B. Related Sections:
 - 1. Division 06 Section "Rough Carpentry" for wood furring/blocking for installing plastic paneling.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For plastic paneling and trim accessories.
- C. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal.
 - a. Kemlite Company Inc.
 - b. Marlite.
 - c. Nudo Products, Inc.

2. Nominal Thickness: Not less than 0.09 inch.
3. Surface Finish: Molded pebble texture
4. Color: As selected by Architect from manufacturer's standard colors.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 1. Color: To match panel color.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Adhesive: As recommended by plastic paneling manufacturer.
- D. Sealant: Sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
 2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.

- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
 - 1. Drill oversized fastener holes in panels and center fasteners in holes.
 - 2. Apply sealant to fastener holes before installing fasteners.
- D. Install trim accessories with adhesive and nails. Do not fasten through panels.
- E. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

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SECTION 072100 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Foundation perimeter under slab insulation.
 - 2. Concealed building insulation.
 - 3. Vapor retarders.

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide glass slag-wool-fiber/rock-wool-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
 - 1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm (13-m/s) air velocity.
 - 2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.

3. Combustion Characteristics: ASTM E 136.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
 1. Available Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company.
 - c. Owens Corning.
 - d. Pactiv Building Products Division.
 - e. Or Equal.
 2. Type IV, 1.55 lb/cu. ft. unless otherwise indicated.

2.3 LOOSE-FILL INSULATION

- A. Cellulosic-Fiber Loose-Fill Insulation in Attic Space: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.

2.4 GLASS-FIBER BLANKET INSULATION

- A. Available Manufacturers:
 1. CertainTeed Corporation.
 2. Guardian Fiberglass, Inc.

3. Johns Manville.
4. Knauf Fiber Glass.
5. Owens Corning.
6. Or equal

- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.5 RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.

2.6 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- C. Spray foam insulation around windows, doors and miscellaneous openings in exterior walls.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.
- D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber sound insulation in cavities formed by framing members according to the following requirements and as indicated on the drawings:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For wood-framed construction, install mineral-fiber sound blankets according to ASTM C 1320 and as follows:
 - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
- E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
- F. Place cellulose loose-fill insulation into spaces indicated, by machine blowing, to comply with ASTM C 1015. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
1. For cellulosic-fiber loose-fill insulation, comply with the Cellulose Insulation Manufacturers Association's Special Report #3, "Standard Practice for Installing Cellulose Insulation."

3.6 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (400 mm) o.c.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Standing-seam metal roof panels.
 - 2. Accessories.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Air Infiltration: Air leakage through assembly of not more than 0.015 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference: 6.24 PSF
- D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- F. Metal roof system must be installed in accordance with UL construction method #448.
- G. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail Resistance: MH.

- H. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 20 lbf/sq. ft. acting inward or outward.
 - 2. Snow Loads: 20 lbf/sq. ft.
 - 3. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/180 of the span.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 180 deg F material surfaces.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Roof curbs.
 - c. Snow guard manufacturer's layout.
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, battens, closures, and other metal roof panel accessories.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch- long Samples for each type of accessory.
- E. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Roof panels and attachments.
 - 2. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, snow guards, and items mounted on roof curbs.

- G. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- H. Qualification Data: For qualified Installer, professional engineer and testing agency.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- J. Field quality-control reports.
- K. Maintenance Data: For metal roof panels to include in maintenance manuals.
- L. Warranties: Samples of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided or existing on roof.

- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of decks, nailers, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's form required in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period at no cost to owner.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's form required in which manufacturer agrees to repair or replace, at no cost to owner, the standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Recycled Content: Provide steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - 2. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 3. Surface: Smooth, straited finish.
 - 4. Exposed Coil-Coated Finish:
 - a. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat or acrylic coated galvalume. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 5. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- B. Panel Sealants:
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
 - b. Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.
 - c. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate panel striations; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal.
 2. Provide optional vinyl weather seal at lock seams.
 - a. Berridge Manufacturing Company – Cee Lock System
 - b. MBCI; a division of NCI Building Systems, L. P. – LokSeam System
 3. Material: Zinc-coated (galvanized) steel sheet, 24 gauge nominal thickness.
 - a. Exterior Finish: 2-coat fluoropolymer
 - b. Color: Galvalume
 4. Panel Coverage: 16.5 inches
 5. Panel Height: 1.5 inches

2.5 ACCESSORIES

- A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 - 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.018 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Roof Curbs: Fabricated from same material as roof panels, minimum 0.048 inch thick; with bottom of skirt profiled to match roof panel profiles, and welded top box and integral full-length cricket. Fabricate curb subframing of minimum 0.0598-inch-thick, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.
 - 1. Insulate roof curb with 1-inch-thick, rigid insulation.

2.6 SNOW GUARDS

- A. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels.
 - 1. Seam-Mounted, Metal, Non-Penetrating Bar Clamp and Tubing Snow Guards: Zink Zamak clamps designed for attachment to standing seam of metal roof panels using stainless steel set screws, with 1" x 1" aluminum square tubing, end caps and 1" barricade plates. Color to match roof panel color.
 - a. Products: Subject to compliance with requirements, provide one of the following or approved equal.
 - 1) Sno-Gem, Inc. Sno Barricade System
 - 2) Approved Equal

2.7 FABRICATION

- A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- B. Examine solid roof sheathing or deck to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- D. For the record, prepare written report, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sheathing Board: Inspect existing sheathing on entire roof surface. Replace unsuitable sheathing.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering High Temperature Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Self-Adhering High Temperature Sheet Underlayment shall cover entire roof, overlap ends of sheets not less than 6 inches.
- B. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

- A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
- B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Install metal roof panels as follows:
 - 1. Commence metal roof panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
 - 2. Field cutting of metal panels by torch is not permitted.
 - 3. Locate and space fastenings in uniform vertical and horizontal alignment. Fastening shall be into wood deck.
 - 4. Provide metal closures at rake edges, rake walls and each side of ridge caps.
 - 5. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
 - 6. Install ridge caps as metal roof panel work proceeds.
 - 7. End Splices: End splices are not allowed.
 - 8. Install metal flashing to allow moisture to run over and off metal roof panels.
- C. Fasteners:
 - 1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.
- D. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, and into existing wood deck using manufacturer's approved fasteners according to manufacturers' written instructions.
- E. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
 - 1. Coat back side of roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.
- F. Joint Sealers: Install gaskets, joint fillers, and sealants for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
 1. Install clips into wood deck with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.7 SNOW GUARD INSTALLATION

- A. Stop-Type Snow Guards: Attach snow guards to metal roof panels with adhesive, sealant, or adhesive tape, as recommended by manufacturer. Do not use fasteners that will penetrate metal roof panels.
 1. Provide snow guards, at locations recommended by snow guard manufacturer.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exposed-fastener, lap-seam metal wall panels.
- B. Related Sections:
 - 1. Division 07 Section "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.3 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 20 lbf/sq. ft., acting inward or outward.
 - 2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; material surfaces.

1.5 SUBMITTALS

- A. **Product Data:** For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.
- B. **Shop Drawings:** Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 - 1. **Accessories:** Include details of the following items, at a scale of not less than 1 inches per 12 inches:
 - a. Flashing and trim.
 - b. Flashing and trim around doors and windows.
 - c. Anchorage systems.
- C. **Samples for Initial Selection:** For each type of metal wall panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- D. **Product Test Reports:** Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- E. **Field quality-control reports.**
- F. **Maintenance Data:** For metal wall panels to include in maintenance manuals.
- G. **Warranties:** Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** Contractor shall have a minimum of five years of experience installing similar metal wall panels.
- B. **Testing Agency Qualifications:** Qualified according to ASTM E 329 for testing indicated.
- C. **Source Limitations:** Obtain each type of metal wall panel from single source from single manufacturer.
- D. **Fire-Resistance Ratings:** Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. **Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed.** Package metal wall panels for protection during transportation and handling.

- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leak-proof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
2. Exposed Coil-Coated Finish:
 - a. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Color as selected by Architect from manufacturer's standard colors.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.3 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS AND LINER PANELS

- A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge M panel or approved equal.
 2. Material: Zinc-coated (galvanized) G90 steel sheet, 26 gauge nominal thickness.
 - a. Exterior Finish: 2-coat fluoropolymer
 - b. Color: As selected by Architect from manufacturer's full range.
 3. Panel Coverage: 36 inches.
 4. Panel Height: .75 inches.
- B. General: Provide factory-formed metal wall & ceiling liner panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge M panel or approved equal.
 2. Material: Zinc-coated (galvanized) G90 steel sheet, 29 gauge nominal thickness.
 - a. Exterior Finish: 2-coat fluoropolymer
 - b. Color: As selected by Architect from manufacturer's full range.
 3. Panel Coverage: 36 inches.
 4. Panel Height: .75 inches.

2.4 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.018-inch minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Provide flashing and trim as required to seal against weather and water intrusion and to provide a finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.5 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.
- E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
 - 1. Examine wall framing to verify that studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - 3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
 - 4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal wall panels.
 - 2. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal wall panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 - 8. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 9. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

- B. Fasteners:
 - 1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
 - 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
 - 6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make all panels weathertight.
 - 7. Panel end splices are not allowed.

3.3 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would

not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured Products:
 - a. Manufactured reglets and counterflashing.
2. Formed Products:
 - a. Formed roof drainage sheet metal fabrications.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Formed equipment support flashing.

B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section "Metal Roof Panels" for installing sheet metal flashing and trim integral with roofing.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install roof edge flashing capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
- C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 1. Temperature Change (Range): 180 deg F, material surfaces.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop-and field-assembled work.
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

- D. Qualification Data: For qualified fabricator.
- E. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.
- F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finishes:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range.

3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 2. Surface: Smooth.
 3. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat or acrylic coated galvalume. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Color: As selected by Architect from manufacturer's full range.
 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied.
1. Products: Subject to compliance with requirements, provide the following or approved equal.
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal.
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Hickman, W. P. Company.
 - d. Keystone Flashing Company, Inc.
 - e. National Sheet Metal Systems, Inc.
 2. Material: Aluminum, 0.024 inch or Galvanized steel, 0.022 inch thick.

3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
6. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
7. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- K. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing: Fabricate in minimum 96-inch- long, but not exceeding 10-foot-long, sections. Furnish with 6-inch- wide, joint cover plates.
 - 1. Fabricate from the following materials:
 - a. Aluminum: 0.050 inch thick.
 - b. Stainless Steel: 0.019 inch thick.
 - c. Galvanized Steel: 0.028 inch thick.
- B. Roof to Wall Transition: Fabricate from the following materials:
 - 1. Aluminum: 0.050 inch thick.
 - 2. Stainless Steel: 0.025 inch thick.
 - 3. Galvanized Steel: 0.034 inch thick.
- C. Base Flashing: Fabricate from the following materials:
 - 1. Aluminum: 0.040 inch thick.
 - 2. Stainless Steel: 0.019 inch thick.
 - 3. Galvanized Steel: 0.028 inch thick.
- D. Counterflashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
 - 2. Stainless Steel: 0.019 inch thick.
 - 3. Galvanized Steel: 0.022 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
 - 2. Stainless Steel: 0.016 inch thick.
 - 3. Galvanized Steel: 0.022 inch thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick.
 - 2. Galvanized Steel: 0.028 inch thick.
- G. Drip Edges: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
 - 2. Stainless Steel: 0.016 inch thick.

3. Galvanized Steel: 0.022 inch thick.

H. Eave, Rake, Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Stainless Steel: 0.016 inch thick.
3. Galvanized Steel: 0.022 inch thick.

I. Gutters & Downspouts: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.
2. Galvanized Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering High Temperature Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim in accordance with roofing manufacturer's recommendations.
 3. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 4. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 5. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 6. Install sealant tape where indicated.
 7. Torch cutting of sheet metal flashing and trim is not permitted.
 8. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws or in accordance with roofing manufacturer's recommendations.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
- G. Rivets: Rivet joints in where indicated and where necessary for strength.

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

END OF SECTION 076200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
 - 1. Division 22 and 23 Sections specifying duct and piping penetrations.
 - 2. Division 26, Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire walls.
 - 2. Fire-resistance-rated horizontal assemblies including ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Installation Responsibility: Assign installation of through-penetration firestop systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 that are produced by one of the following manufacturers or approved equal:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. RectorSeal Corporation (The).
8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner may engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.6 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems with No Penetrating Items:

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Intumescent putty.
 - d. Mortar.

C. Firestop Systems for Metallic Pipes, Conduit, or Tubing and UL listed.

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Intumescent putty.
 - d. Mortar.

D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing and UL listed.

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Intumescent putty.
 - d. Intumescent wrap strips.
 - e. Firestop device.

E. Firestop Systems for Electrical Cables UL listed.

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Silicone sealant.
 - c. Intumescent putty.
 - d. Silicone foam.
 - e. Pillows/bags.

F. Firestop Systems for Cable Trays UL listed.

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Intumescent putty.
 - c. Silicone foam.
 - d. Pillows/bags.
 - e. Mortar.

G. Firestop Systems for Insulated Pipes UL listed.

1. Type of Fill Materials: One or more of the following:
 - a. Latex sealant.
 - b. Intumescent putty.
 - c. Silicone foam.
 - d. Intumescent wrap strips.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Latex joint sealants.
 - 3. Urethane joint sealants.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
- B. Product Data: For each joint-sealant product indicated.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Qualification Data: For qualified Installer
- E. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- F. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone

testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000 UltraGlaze SSG4000AC.
 - c. May National Associates, Inc.; Bondaflex Sil 200 GPN Bondaflex Sil 201 FC.
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - f. Tremco Incorporated; Proglaze SSG Tremsil 600.
 - g. Or equal.
- B. Mildew-Resistant, Single-Component, Non-sag, and Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; 898.
 - b. Or equal.

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; Bondaflex 600 Bondaflex Sil-A 700.
 - d. Pecora Corporation; AC-20+.
 - e. Schnee-Morehead, Inc.; SM 8200.
 - f. Tremco Incorporated; Tremflex 834.
 - g. Or equal.

2.4 URETHANE JOINT SEALANTS

- A. Single-Component, Non-sag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal.
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Bostik, Inc.; Chem-Calk 900.
 - c. Pacific Polymers International, Inc.; Elasto-Thane 230 Type II.
 - d. Pecora Corporation; Dynatrol I-XL.
 - e. Polymeric Systems, Inc.; Flexiprene 1000.
 - f. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - g. Tremco Incorporated; Dymonic.

2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 4. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal surfaces.
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between metal panels.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - f. Control and expansion joints in ceilings and other overhead surfaces.
 - g. Saw cut joints in slab
 2. Urethane Joint Sealant: Single component, nonsag, neutral curing.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Saw cut joints in slab
 - c. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Other joints as indicated.
 2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone
 3. Joint-Sealant Color As selected by Architect from manufacturer's full range of colors

END OF SECTION 079200

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SECTION 081100 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes steel doors and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 087100 - "Door Hardware"

1.3 SUBMITTALS

- A. Product Data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- B. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
- C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
 - 1. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- D. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for factory-finished doors and frames.

1.4 QUALITY ASSURANCE

- A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per ASTM E 152, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.

- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Exterior Steel Doors and Frames:
 - a. Curries Co.
 - b. Mesker Door.
 - c. Steelcraft.
 - d. or equal
 - 2. Prefinished Interior Steel Frames:
 - a. Timely Industries, Classic C Series Frame.
 - b. or equal

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M).
- B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M).
- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality complying with ASTM A 526 (ASTM A 526M), with ASTM A 525, G60 zinc coating, mill phosphatized.
- D. Supports and Anchors: Fabricated from not less than 18-gage thick galvanized sheet steel.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.3 DOORS

- A. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:
 - 1. Exterior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 18-gauge galvanized steel sheet faces.

2.4 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Fabricate frames of cold-rolled or hot-rolled steel sheet (at fabricator's option).
 - 1. Fabricate frames with mitered or coped corners, continuously welded construction for exterior applications and knocked down for field assembly at interior applications.
 - 2. Provide kerf frames to receive manufactures standard weather stripping for exterior doors as shown on drawings and schedule.
 - 3. Form exterior frames from 16-gauge thick galvanized steel sheet.
 - 4. Form interior frames from 18 gauge steel sheet.

- B. Weather Stripping: Provide manufacturers standard continuous KERFT frames for weather stripping in jambs and head.
- C. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- D. Plaster Guards: Provide minimum 0.0179-inch- (0.45-mm-) thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
- E. Casings: Provide galvanized unfinished casings with corner alignment for all interior door frames.
 - 1. Casings shall be supplied by the same manufacturer of interior pre-finished metal frames.

2.5 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.
 - 1. Internal Construction: One of the following manufacturer's standard core materials according to SDI standards:
 - a. Rigid polystyrene conforming to ASTM C 578.
 - 2. Clearances: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between non-fire-rated pairs of doors. Not more than 3/4 inch (19 mm) at bottom or where doors have thresholds, per threshold manufacturers recommendations.
 - 3. Fire Doors: Provide clearances according to NFPA 80.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- E. Galvanized Steel Doors, Panels, and Frames: For the following locations, fabricate doors, panels, and frames from galvanized steel sheet according to SDI 112. Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.0635-inch- (1.6-mm-) thick galvanized steel channels, with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.
 - 1. At exterior locations.
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with U-value rating of 0.24 Btu/sq. ft. x h x deg F or better.

- H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.
- I. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- J. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- K. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel
 - 1. Provide screw-applied, removable, glazing beads on inside of glass and other panels in doors and frames.
- L. Casing retainer clips: Pre-finished metal frames for interior are to be furnished with mechanically fastened casing retainer clips. Field install casing retainer clips on interior face of hollow metal frames per manufacturers recommendations.

2.6 FINISHES, GENERAL

- A. All Pre-Finished steel frames.
 - 1. Frame Units: Pre-finished with factory applied impact resistant, polyester baked enamel finish or optional electrostatic applied water based paint system.
 - 2. Protect frames from any damage or scratching that would remove galvanized finish. Repair any damaged areas.
 - 3. Color: As selected by Architect from standard and premium colors.
- B. All hollow metal doors are to be finished as follows:
 - 1. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
 - 2. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.
 - 3. Apply primers and organic finishes to doors and frames after fabrication.

2.7 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.
- B. Factory Priming for Field-Painted Finish: Apply air-dried primer specified below immediately after cleaning and pretreatment.
 - 1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

2.8 STEEL SHEET FINISHES

- A. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.
- B. Galvanized Unfinished: Provide for interior pre-finished metal frames, manufacturer's standard galvanized unfinished coating to all metal frames and snap on metal trim.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated.
 - 1. Except for frames located in masonry, place frames before constructing enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 - 3. At in-place concrete construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with machine screws and anchorage devices.
 - 4. At gypsum board partitions, install knock-down, slip-on, drywall frames.
 - 5. Install casing on all interior frames and interior face of exterior hollow metal frames as indicated on the drawings.
 - 6. Install fire-rated frames according to NFPA 80.
- C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.
 - 1. Fire-Rated Doors: Install with clearances specified in NFPA 80.
 - 2. Smoke-Control Doors: Comply with NFPA 105.

3.2 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 081100

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SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electrically operated sectional doors and manually operated sectional doors.
- B. Related Sections:
 - 1. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
 - 2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.
- C. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283 or DASMA 105.
 - 1. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph.
- D. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Seismic Component Importance Factor: 1.5.
- E. Operation Cycles: Provide sectional door components and operators capable of operating for not less than 50,000 cycles for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.

2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 1. Include similar Samples of accessories involving color selection.
- D. Delegated-Design Submittal: For sectional doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Detail fabrication and assembly of seismic restraints.
 2. Summary of forces and loads on walls and jambs.
- E. Qualification Data: For qualified Installer.
- F. Seismic Qualification Certificates: For sectional doors, accessories, and components, from manufacturer.
- G. Maintenance Data: For sectional doors to include in maintenance manuals.
- H. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain sectional doors from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Standard for Sectional Doors: Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.

- d. Delamination of exterior or interior facing materials.
- 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL DOOR SECTIONS

- A. Exterior Section Faces and Frames: Fabricate from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.
 - 1. Fabricate section faces from single sheets to provide sections not more than 24 inches high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
 - 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch- thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
- C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.
- D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
- E. Provide reinforcement for hardware attachment.
- F. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior face sheet. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:
 - 1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
- G. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:

1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.
- 2.2 TRACKS, SUPPORTS, AND ACCESSORIES
- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653/A 653M for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 2 inches apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 - B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
 1. Vertical Track Assembly: Track with wall jamb brackets attached to track and attached to wall.
 2. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.
 - C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.
 - D. Windows: Manufacturer's standard window units of type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.
- 2.3 HARDWARE
- A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
 - B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 16 feet wide unless otherwise recommended by door manufacturer.
 - C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch diameter roller tires for 3-inch wide track and 2-inch diameter roller tires for 2-inch wide track.
 - D. Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

2.4 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
 - 2. Keys: Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.
- C. Cables: Galvanized-steel lifting cables with cable safety factor of at least 5 to 1.
- D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- F. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation. All doors as noted on the door schedule shall have electric operators.
 - 1. Comply with NFPA 70.
 - 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
- D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified unless otherwise indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115
 - c. Hertz: 60.
 - 2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
 - 3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in/sec. and not more than 12 in/sec. without exceeding nameplate ratings or service factor.
 - 4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - 6. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
 - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
 - 2. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
 - 1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.7 DOOR ASSEMBLY

- A. Steel Sectional Door: Sectional door formed with hinged sections.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Clopay Building Products; a Griffon company.
 - b. Overhead Door Corporation.
 - c. Raynor.
 - d. Haas Door
- B. Operation Cycles: Not less than 50,000.
- C. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 zinc coating.
 - 1. Section Thickness: 2 inches.
 - 2. Exterior-Face, Steel Sheet Thickness - 0.034-inch min. (20 Gauge) thickness.
 - a. Surface: Manufacturer's standard.
 - 3. Insulation: Foamed in place R-15 min.
 - 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet of 0.018-inch min. (26 gauge) thickness.
- D. Track Configuration: Low Headroom Track.
- E. Weatherseals: Fitted to bottom and top and around entire perimeter of door.
- F. Windows: Approximately 36 by 12 inches with curved corners and spaced apart the approximate distance as indicated on Drawings; in one row at height indicated on Drawings; installed with insulated glazing of the following type:
 - 1. Clear Acrylic Plastic: 3 mm thick, transparent, smooth or polished, and formulated to be UV resistant.
- G. Counterbalance Type: Torsion spring.
- H. Manual Door Operator: Chain-hoist operator.
- I. Electric Door Operator:
 - 1. Usage Classification: Heavy duty, 60 to 90 cycles per hour
 - 2. Operator Type: Trolley or Jackshaft,
 - 3. Motor Exposure: Exterior, dusty, wet, or humid.
 - 4. Emergency Manual Operation: Chain type.
 - 5. Obstruction-Detection Device: Automatic photoelectric sensor or electric sensor edge on bottom bar.
 - 6. Remote-Control Station: Interior

J. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
 3. Repair galvanized coating on tracks according to ASTM A 780.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weathertight fit around entire perimeter.
- D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.
- E. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

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SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes operable wood-framed windows of the following type:
 - 1. Aluminum clad Wood Casement windows.

1.3 DEFINITIONS

- A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
- B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
 - 1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.
- C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.
- D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide wood windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of test size indicated below:
 - 1. Size indicated on Drawings.
- B. Structural Performance: Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
 - 1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - a. Basic Wind Speed: 90 mph.
 - 2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.

1.5 SUBMITTALS

- A. **Product Data:** Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of wood window indicated.
- B. **Shop Drawings:** Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
 - 1. Mullion details, including reinforcement and stiffeners.
 - 2. Joinery details.
 - 3. Expansion provisions.
 - 4. Flashing and drainage details.
 - 5. Weather-stripping details.
 - 6. Glazing details.
 - 7. Window cleaning provisions.
 - 8. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of wood windows and used to determine the following:
 - a. Structural test pressures and design pressures from basic wind speeds indicated.
 - b. Deflection limitations of glass framing systems.
- C. **Samples for Initial Selection:** For units with factory-applied color finishes.
 - 1. Include similar Samples of hardware and accessories involving color selection.
- D. **Product Schedule:** For wood windows. Use same designations indicated on Drawings.
- E. **Qualification Data:** For Installer.
- F. **Maintenance Data:** For operable window sash, operating hardware, weather stripping and finishes to include in maintenance manuals.
- G. **Warranty:** Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An installer acceptable to wood window manufacturer for installation of units required for this Project.
- B. **Manufacturer Qualifications:** A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.
- C. **Source Limitations:** Obtain wood windows through one source from a single manufacturer.
- D. **Fenestration Standard:** Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Provide AAMA-certified wood windows with an attached label.
- E. **Glazing Publications:** Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify wood window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating wood windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of wood, metals, vinyl, other materials, and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. Warranty Period:
 - a. Window: Two years from date of Substantial Completion.
 - b. Glazing: 10 years from date of Substantial Completion.
 - c. Metal Finish: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
- B. Manufacturers: Subject to compliance with requirements.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following or approved equal.
 - 1. Aluminum-Clad Wood Windows:
 - a. Marvin Windows and Doors.
 - b. Norco Premium Collection; JELD-WEN, Inc.
 - c. Peachtree Doors and Windows; TPC Acquisition, Inc.
 - d. Pella Corporation.
 - e. Weather Shield Mfg., Inc.

2.2 MATERIALS

- A. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.

- B. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to exterior exposed wood members. Provide aluminum alloy and temper recommended by wood window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, and not less than 16,000-psi minimum yield strength.
 - 1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 3. Baked-Enamel Finish for Extrusions and Sheet: Manufacturer's standard baked enamel complying with AAMA 2603 and paint manufacturer's written specifications for cleaning, conversion coating, and painting.
 - a. Color: As selected by Architect from manufacturer's standard colors.
- C. Wood Trim and Glazing Stops: Material and finish to match frame members.
- D. Clad Trim and Glazing Stops: Clad-wood material and finish to match clad frame members.
- E. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.
- F. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- G. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- H. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed.

2.3 WINDOW

- A. Window Type: Casement
- B. Condensation-Resistance Factor (CRF): Provide wood windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- C. Thermal Transmittance: Provide wood windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to ASTM E 1423.
 - 1. U-Factor: 0.40 Btu/sq. ft. x h x deg F or less.
- D. Solar Heat-Gain Coefficient (SHGC): Provide wood windows with a whole-window SHGC maximum of 0.50 according to NFRC 200 procedures.

- E. Sound Transmission Class (STC): Provide glazed windows rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- F. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
 - 1. Maximum Rate: 0.3 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.
- G. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
 - 1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. or more than 15 lbf/sq. ft.
- H. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.
- I. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.

2.4 GLAZING

- A. Glass Clear, insulating-glass units, with low-E coating.
- B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- C. HARDWARE
- D. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with wood and aluminum cladding; designed to smoothly operate, tightly close, and securely lock wood windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze, extruded, cast, or wrought aluminum, or nonmagnetic stainless steel.
- E. Sill Cap/Track: Rigid PVC or other weather-resistant plastic track with manufacturer's standard integral color, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
- F. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
- G. Roller Assemblies: Low-friction design.

2.5 INSECT SCREENS

- A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on outside of window and provide for each operable exterior sash or ventilator.
 - 1. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows," Residential R-20 class.

- B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 - 1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
 - 2. Finish: Manufacturer's standard.
- C. Glass-Fiber Mesh Fabric: 20-by-20 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656.
 - 1. Mesh Color: Charcoal gray.
- D. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch-diameter, coated aluminum wire.
 - 1. Wire-Fabric Finish: Charcoal gray.

2.6 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate wood windows that are reglazable without dismantling sash or ventilator framing.
- C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.
- D. Factory machine windows for openings and for hardware that is not surface applied.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

2.7 WOOD FINISHES

- A. Factory-Finished Windows: Provide manufacturer's pre-finished wood interior.
 - 1. Color: As selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.
 - 1. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085200

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Other doors to the extent indicated.
 - 2. Cylinders for doors specified in other Sections.
- B. Related Sections include the following:
 - 1. Division 8 Section "Standard Steel Doors and Frames".

1.3 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- C. Warranty: Special warranty specified in this Section.
 - 1. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
- D. Other Action Submittals:
 - 1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
 - 2) Complete designations of every item required for each door or opening including name and manufacturer.
 - 3) Fastenings and other pertinent information.
 - 4) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) Door and frame sizes and materials.

- c. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
- 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - 1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Installer shall have warehousing facilities in Project's vicinity.
 - 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- B. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to Owner.

1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, except as follows:

- a. Exit Devices: Two years from date of Substantial Completion.
- b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in door and frame schedule and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
 - 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
 - 1. Three Hinges: For doors with heights 61 to 90 inches.
 - 2. Four Hinges: For doors with heights 91 to 120 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:
 - 1. Entrance Doors: Heavy-weight hinges.
 - 2. Doors with Closers: Antifriction-bearing hinges.
 - 3. Interior Doors: Antifriction-bearing hinges.
- D. Hinge Options: Where indicated in door hardware sets or on Drawings:
 - 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
- E. Fasteners: Comply with the following:
 - 1. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
 - 1. Baldwin Hardware Corporation (BH).
 - 2. Bommer Industries, Inc. (BI).
 - 3. Cal-Royal Products, Inc. (CRP).
 - 4. Hager Companies (HAG).
 - 5. Lawrence Brothers, Inc. (LB).
 - 6. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - 7. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - 8. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
 - 9. Or Equal

2.4 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
 - 1. Levers: Wrought Forged Cast.
 - 2. Escutcheons: Wrought Forged Cast.
 - 3. Dummy Trim: Match lever lock trim and escutcheons.
 - 4. Lockset Designs: Provide design indicated on Drawings or, if sets are provided by another manufacturer, provide designs that match those designated.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch bolt throw.
- E. Backset: 2-3/4 inches, unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
 - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 2. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 3. Strikes for Interconnected Locks and Latches: BHMA A156.12.
 - 4. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 - 5. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 6. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

7. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 1. Bored Locks: BHMA A156.2.
 2. Mortise Locks: BHMA A156.13.
 3. Interconnected Locks: BHMA A156.12.
- B. Bored Locks: BHMA A156.2, Grade 1;
 1. Available Manufacturers or approved equal:
 - a. Best Access Systems; Div. of The Stanley Works (BAS).
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - d. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 - e. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.6 AUXILIARY LOCKS AND LATCHES

- A. Auxiliary Locks: BHMA A156.5, Grade 1.
 1. Available Manufacturers or approved equal:
 - a. Best Access Systems; Div. of The Stanley Works (BAS).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - c. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
 - d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.7 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors.
- B. Dustproof Strikes: BHMA A156.16, Grade 1.

2.8 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.
 - 1. Match design for locksets and latchsets, unless otherwise indicated.
- G. Available Manufacturers or approved equal:
 - 1. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - 2. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - 3. Monarch Exit Devices & Door Hardware; an Ingersoll-Rand Company (MON).
 - 4. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - 5. Von Duprin; an Ingersoll-Rand Company (VD).
 - 6. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.9 LOCK CYLINDERS

- A. Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 - 1. Number of Pins: Six
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 - a. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).
- C. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 - 1. Removable Cores: Core insert, removable by use of a special key; for use only with core manufacturer's cylinder and door hardware.
- D. Construction Keying: Comply with the following:
 - 1. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
 - a. Replace construction cores with permanent cores as directed by Owner.
 - b. Furnish permanent cores to Owner for installation.
- E. Manufacturer: Same manufacturer as for locks and latches.

2.10 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
 - 1. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE." Information to be furnished by Owner.
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:

- a. Cylinder Change Keys: Three.
- b. Master Keys: Five.

2.11 OPERATING TRIM

- A. Standard: BHMA A156.6.
- B. Materials: Fabricate from aluminum brass bronze stainless steel, unless otherwise indicated.
- C. Available Manufacturers or approved equal:
 - 1. Burns Manufacturing Incorporated (BM).
 - 2. Don-Jo Mfg., Inc. (DJO).
 - 3. Forms + Surfaces (FS).
 - 4. Hager Companies (HAG).
 - 5. Hiawatha, Inc. (HIA).
 - 6. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - 7. Rockwood Manufacturing Company (RM).
 - 8. Trimco (TBM).

2.12 CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- D. Surface Closers: BHMA A156.4, Grade 1 unless Grade 2 is indicated. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
 - 1. Available Manufacturers or approved equal:
 - a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
 - b. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - c. LCN Closers; an Ingersoll-Rand Company (LCN).
 - d. Norton Door Controls; an ASSA ABLOY Group company (NDC).
 - e. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - f. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.13 PROTECTIVE TRIM UNITS

- A. Size: 1-1/2 inches less than door width on push side and 1/2 inch less than door width on pull side, by height specified in door hardware sets.
- B. Fasteners: Manufacturer's standard machine or self-tapping screws.

2.14 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1 unless Grade 2 is indicated.
 - 1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
- B. Mechanical Door Holders: BHMA A156.16, Grade 1 unless Grade 2 is indicated.
- C. Combination Floor and Wall Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.
- D. Combination Overhead Stops and Holders: BHMA A156.8, Grade 1 unless Grade 2 is indicated.
- E. Silencers for Wood Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum 5/8 by 3/4 inch fabricated for drilled-in application to frame.
- F. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.
- G. Available Manufacturers or approved equal:
 - 1. Architectural Builders Hardware Mfg., Inc. (ABH).
 - 2. Baldwin Hardware Corporation (BH).
 - 3. Burns Manufacturing Incorporated (BM).
 - 4. Cal-Royal Products, Inc. (CRP).
 - 5. Don-Jo Mfg., Inc. (DJO).
 - 6. Door Controls International (DCI).
 - 7. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
 - 8. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
 - 9. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
 - 10. Hager Companies (HAG).
 - 11. HES, Inc.; an ASSA ABLOY Group company (HES).
 - 12. Hiawatha, Inc. (HIA).
 - 13. IVES Hardware; an Ingersoll-Rand Company (IVS).
 - 14. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 - 15. Rockwood Manufacturing Company (RM).
 - 16. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
 - 17. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
 - 18. Trimco (TBM).

2.15 DOOR GASKETING

- A. Standard: BHMA A156.22.
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

- D. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
- G. Available Manufacturers or approved equal:
 - 1. Hager Companies (HAG).
 - 2. M-D Building Products, Inc. (MD).
 - 3. National Guard Products (NGP).
 - 4. Pemko Manufacturing Co. (PEM).
 - 5. Reese Enterprises (RE).
 - 6. Sealeze; a unit of Jason Incorporated (SEL).
 - 7. Zero International (ZRO).

2.16 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ANSI A117.1.
- C. Available Manufacturers or approved equal:
 - 1. Hager Companies (HAG).
 - 2. M-D Building Products, Inc. (MD).
 - 3. National Guard Products (NGP).
 - 4. Pemko Manufacturing Co. (PEM).
 - 5. Reese Enterprises (RE).
 - 6. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 - 7. Sealeze; a unit of Jason Incorporated (SEL).
 - 8. Zero International (ZRO).
 - 9. Or Equal

2.17 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Steel Machine or Wood Screws: For the following fire-rated applications:
 - a. Mortise hinges to doors.
 - b. Strike plates to frames.
 - c. Closers to doors and frames.
 - 3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
 - a. Surface hinges to doors.
 - b. Closers to doors and frames.
 - c. Surface-mounted exit devices.
 - 4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 5. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.18 FINISHES

- A. Standard: BHMA A156.18, 626 Satin Chromium Plated finish for the Storage Building.
- B. Standard: BHMA A156.18, 626 Satin Chromium Plated finish for the Storage Building.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

- B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Key Control System: Tag keys as determined by final keying schedule.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SETS FOR WORKSHOP / STORAGE BUILDING

GROUP 1 Door 101B

1	Lockset	ND70PD-SAT	Schlage
1	Closer	4040	LCN
1 ½ PR	Hinges	5BB1-HW-4 ½ X4 1/2	Ives
1 _{set}	Weather stripping	S88	Pemko
1	Threshold	154	Pemko
1	Door Shoe	217	Pemko

GROUP 2 Door 102

1	Lockset	ND40S-SAT	Schlage
1 ½ PR	Hinges	5BB1-HW-4 ½ X4 1/2	Ives
1	Floor Stop	WS430	Ives
1	Gasket Set		

GROUP 3 Door 103

1	Lockset	ND80PD-SAT	Schlage
1 ½ PR	Hinges	5BB1-HW-4 ½ X4 1/2	Ives
1	Floor Stop	WS430	Ives
1 _{set}	Weather stripping	S88	Pemko
1	Threshold	154	Pemko
1	Door Shoe	217	Pemko

GROUP 4 Doors 101C

1	Latchset	ND10S-SAT	Schlage
1 ½ PR	Hinges	5BB1-HW-4 ½ X4 1/2	Ives
1	Floor Stop	WS430	
1 _{set}	Weather stripping	S88	Pemko
1	Threshold	154	Pemko
1	Door Shoe	217	Pemko

GROUP 5 Pair Doors 104

1	Lockset	ND70PD-SAT	Schlage
3 PR	Hinges	5BB1-HW-4 ½ X4 1/2	Ives
1	Weather stripping	S88	Pemko
2	Surface	Bolts454	Ives
1	Door Pull and Push Plate for inactive leaf		
1	Astragal	352 R	Pemko

END OF SECTION 087100

SECTION 092600 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard assemblies.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for wood framing and furring, and gypsum sheathing applied over wood framing.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory." GA-600, "Fire Resistance Design Manual."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
 - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Gypsum Board and Related Products:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.
 - e. Or Equal

2.2 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
 - 1. Type X:
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered.
 - c. Location: Vertical surfaces, unless otherwise indicated.

2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Pre-filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Ceilings: Coordinate installation of ceiling systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install insulated blankets before installing gypsum panels.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
- K. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.4 PANEL APPLICATION METHODS

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally, (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.5 INSTALLING TRIM ACCESSORIES

- A. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.6 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 4 is suitable for surfaces receiving light-textured finish wallcoverings and flat paints. It is generally the standard exposed finish.
 2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
- E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

END OF SECTION 092600

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SECTION 096530 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allstate Rubber Corp.; Stoler Industries.
 - b. Armstrong World Industries, Inc.
 - c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - d. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - e. Estrie Products International; American Biltrite (Canada) Ltd.
 - f. Flexco, Inc.
 - g. Johnsonite.
 - h. Mondo Rubber International, Inc.
 - i. Musson, R. C. Rubber Co.
 - j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - k. PRF USA, Inc.
 - l. Roppe Corporation, USA.
 - m. VPI, LLC; Floor Products Division.
 - n. Or Equal

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- #### A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- C. Clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096530

SECTION 099120 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Steel.
 - 3. Wood.
 - 4. Gypsum board.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. Diamond Vogel Paints.
 3. PPG Architectural Finishes, Inc.
 4. Sherwin-Williams Company (The).
 5. Approved Equal

2.2 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range

2.3 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.

2.4 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.

2.5 LATEX PAINTS

- A. Interior Latex (Semi-gloss): MPI #54 (Gloss Level 5).

2.6 FLOOR COATINGS

- A. Interior Concrete Floor Stain: MPI #58.
- B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulates.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.

3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- I. Spray-Textured Ceiling Substrates: Do not begin paint application until surfaces are dry.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
 - a. Non-insulated metal piping mounted to wall or ceiling.
 - b. Uninsulated plastic piping mounted to wall or ceiling.
 - c. Pipe hangers and supports.
 - d. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - e. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

- 1. Concrete Stain System: MPI INT 3.2E.
 - a. First Coat: Interior concrete floor stain.
 - b. Topcoat: Interior concrete floor stain.
- 2. Clear Sealer System: MPI INT 3.2F.
 - a. First Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - b. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).

B. Steel Substrates:

- 1. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (semi-gloss)

C. Galvanized-Metal Substrates:

- 1. Alkyd System: MPI INT 5.3C.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (semi-gloss)

D. Dressed Lumber Substrates: Including architectural woodwork

- 1. Latex System: MPI INT 6.3T.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (semi-gloss) (gloss).

E. Dimension Lumber Substrates, Non-traffic Surfaces: Including exposed joists exposed beams.

- 1. Latex System: MPI INT 6.2D.
 - a. Prime Coat: Interior latex-based wood primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell)

F. Gypsum Board Substrates:

- 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex matching topcoat.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (semi-gloss).

END OF SECTION 099120

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SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Plaques.
- 2. Panel signs.

- B. Related Sections include the following:

- 1. Division 01 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
- 2. Division 22 Section "Plumbing" for labels, tags, and nameplates for plumbing systems and equipment.
- 3. Division 23 Section "Heating Ventilating and Air Conditioning" for labels, tags, and nameplates for HVAC systems and equipment.
- 4. Division 26 Sections for electrical service and connections.
- 5. Division 26 Section "Electrical" for labels, tags, and nameplates for electrical equipment.

1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication and installation details for signs.

- 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
- 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- 3. Wiring Diagrams: Power, signal, and control wiring.

- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:

- 1. Acrylic sheet.
- 2. Polycarbonate sheet.
- 3. Fiberglass sheet.

- D. Qualification Data: For fabricator.

- E. Maintenance Data: For signs to include in maintenance manuals.

- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors and sign lamination.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- B. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lbf/in. (854 J/m) per ASTM D 256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. (62 MPa) per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. (2345 MPa) per ASTM D 790.

4. Heat Deflection: 265 deg F (129 deg C) at 264 lbf/sq. in. (1.82 MPa) per ASTM D 648.
5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.

2.2 PANEL SIGNS – All Restrooms, Locker rooms, and Classrooms. (Classrooms shall post maximum occupant load) All accessible parking spaces.

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. Allen Industries Architectural Signage
4. Allenite Signs; Allen Marking Products, Inc.
5. APCO Graphics, Inc.
6. ASI-Modulex, Inc.
7. Best Sign Systems Inc.
8. Bunting Graphics, Inc.
9. Fossil Industries, Inc.
10. Gemini Incorporated.
11. Grimco, Inc.
12. Innerface Sign Systems, Inc.
13. InPro Corporation
14. Matthews International Corporation; Bronze Division.
15. Mills Manufacturing Company.
16. Mohawk Sign Systems.
17. Nelson-Harkins Industries.
18. Seton Identification Products.
19. Signature Signs, Incorporated.
20. Supersine Company (The)
21. Or Equal

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:

1. Acrylic Sheet: 0.060 inch (1.52 mm) thick.
2. PVC Sheet: 0.060-inch- (1.52-mm-) thick, extruded, high-impact PVC plastic in color to match face color.
3. Edge Condition: Square cut.
4. Corner Condition: Square.
5. Mounting: Unframed.
 - a. Manufacturer's standard anchors for substrates encountered.
6. Color: As selected by Architect from manufacturer's full range .
7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.

C. Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:

1. Acrylic Sheet: 0.060 inch (1.52 mm) thick.
2. Edge Condition: Square cut.
3. Corner Condition: Square.
4. Mounting: Unframed.
 - a. Manufacturer's standard noncorroding anchors for substrates encountered.

- 5. Color: As selected by Architect from manufacturer's full range.
- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).
- E. Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Opaque Acrylic Sheet: Fill engraved copy with enamel.
 - 2. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with enamel. Apply opaque background color coating to back face of acrylic sheet.

2.3 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- B. Provide breakaway hot-dip galvanized anchors and sign posts where indicated on the drawings.
- C. Signs, sign posts, and anchors shall meet the requirements of the most current edition of the Missouri Standard Specifications for Highway Construction when placed in or adjacent to MoDOT right of way.

2.4 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
 - 3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
 - 4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 5. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 - 6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
 - 7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 105220 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Fire extinguisher mounting brackets.

1.3 SUBMITTALS

- A. Product data for cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.
- B. Coordination: Furnish inserts, sleeves and anchorages which must be built into work for installation. Coordinate delivery with other work to avoid delay.
- C. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Ansul Fire Protection.
 - 2. Badger-Powhatan.
 - 3. American Specialties Inc.
 - 4. Bobrick Washroom Equipment, Inc.
 - 5. Croker Div., Fire-End and Croker Corp.
 - 6. Filtrine Manufacturing.
 - 7. Lyon Metal Products.
 - 8. J.L. Industries.
 - 9. Larsen's Manufacturing Co.
 - 10. Modern Metal Products by Muckle.
 - 11. Potter-Roemer, Inc.
 - 12. Samson Metal Products, Inc.

2.2 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers for each cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, that comply with authorities having jurisdiction.
- B. Multipurpose Dry Chemical Type: UL-rated 4-A: 60-B: C, 10-lb nominal capacity, in enameled steel container.

2.3 MOUNTING BRACKETS

- A. Brackets: Designed to prevent accidentally dislodging extinguisher, of sizes required for type and capacity of extinguisher indicated, in plated finish.
 - 1. Provide brackets for extinguishers not located in cabinets.
 - 2. Identify bracket-mounted extinguishers with FIRE EXTINGUISHER in red letter decals applied to wall surface. Use letter size, style, and location as selected by Architect.

2.4 CABINETS

- A. Larsen's or equal
 - 1. Architectural Series, 2409-6R, Vertical Duo
 - 2. Architectural Series, 2409-SM, Vertical Duo
 - a. 1/4" acrylic glazing
 - b. Finish: Manufacturer's standard baked enamel finish, color white.
- B. Identify fire extinguisher in cabinet with FIRE EXTINGUISHER lettering applied to door. Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.
 - 1. Dye cut lettering, color red

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Follow manufacturer's printed instructions for installation.
- B. Install in locations indicated.
 - 1. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
 - 2. Fasten mounting brackets and cabinets to structure, square and plumb.

END OF SECTION 105220

SECTION 108010 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Childcare accessories.
 - 4. Underlavatory guards.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated on Drawings.
 - 2. Identify products using designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 WASHROOM ACCESSORIES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. General Accessory Manufacturing Co. (GAMCO).
 6. Or Equal
- B. Toilet Tissue (Roll) Dispenser:
1. Description: Double-roll dispenser.
 2. Mounting: Surface mounted.
 3. Operation: Noncontrol delivery with theft-resistant spindle
 4. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Combination Towel (Folded) Dispenser/Waste Receptacle:

1. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
2. Mounting: Recessed
 - a. Designed for nominal 4-inch wall depth.
3. Minimum Towel-Dispenser Capacity: 300C-fold or 400multifold paper towels.
4. Minimum Waste-Receptacle Capacity: 1.6gal. (45.4 L).
5. Material and Finish: Stainless steel, No. 4 finish (satin)
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

D. Liquid-Soap Dispenser:

1. Description: Designed for dispensing soap in lather form.
2. Mounting: Horizontally oriented, surface mounted.
3. Capacity: 40 fl. Oz.
4. Materials: Stainless steel, No. 4 finish (satin)
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

E. Grab Bar:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings .

F. Mirror Unit:

1. Frame: Stainless-steel channel
 - a. Corners: Manufacturer's standard.
2. Integral Shelf: 5 inches (127 mm) deep.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

2.3 CHILDCARE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Infant Care Products Inc.
2. American Specialties, Inc.
3. Brocar Products, Inc.
4. General Accessory Manufacturing Co. (GAMCO).
5. Koala Corporation.
6. Safe-Strap Company, Inc.
7. Or Equal

B. Diaper-Changing Station :

1. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of 250-lb (113-kg) static load when opened.
2. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: High-density polyethylene in manufacturer's standard color.
5. Liner Dispenser: Built in.

2.4 UNDERLAVATORY GUARDS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Plumberex Specialty Products, Inc.
2. TCI Products.
3. Truebro, Inc.
4. Or Equal

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded-plastic, white.

2.5 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 108010

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SECTION 220000 - GENERAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

- A. This work shall include all plant, labor, material, and equipment as required to furnish and install mechanical work as shown on the drawings and as hereinafter specified. All plant, labor, material and equipment not shown on the drawings and not specified but necessary and incidental to provide first class and complete installations of mechanical work shall be included in this contract.
- B. All licenses and permits required for the performance of this work shall be included in this contract. All equipment under this division shall be installed under competent supervisory service furnished by the Contractor and where necessary shall include services of special erection and operating engineers.

1.3 MISCELLANEOUS CONDITIONS

- A. All installed materials and equipment shall be new and of the best quality and design, and shall be free from defects and imperfections.
- B. All work shall be performed in accordance with the requirements Article 5 of the General Conditions (Compliance with Laws, Regulations and Inspections), and as specified below.

All work shall be in accordance with all local codes and ordinances including the latest requirements of the Underwriters Laboratories, Inc. (UL), the National Fire Protection Association (NFPA), the Building Official and Code Administrators International, Inc. (BOCA), the International Mechanical Code and the International Plumbing Code. Laws, codes and ordinances conflicting with specifications and drawings shall govern, unless exceeded by specifications and drawings in quality or quantity.

- C. Contractor shall be responsible for coordinating this work with the work of other trades on the project including responsibility for all material and equipment deliveries and installation in a manner so as to prevent delay in construction schedule.
- D. Acceptance of the work shall be subject to the condition that all systems, equipment, apparatus and appliances included in the work shall operate and perform as designed and selected with respect to efficiency, capacity and quietness. Acceptance of the work shall further be subject to the conditions that any time within one year of final approval date any defective part of the work resulting from faulty workmanship or material shall be immediately amended, repaired, or replaced without additional cost to the Owner.

1.4 INSPECTION OF AREA

- A. The Contractor shall be responsible for field inspection of the area before preparing his bid.

1.5 VARIATION FROM SPECIFICATIONS

- A. Variations from the specifications will be considered, provided attention is drawn to such variations and details given for the variations. The Owner reserves the right to reject any and all variations or to accept the variation which it deems most suitable without recourse.

1.6 CLEANING UP

- A. The Contractor shall remove from the Owner's property all temporary structures, rubbish and waste material resulting from the construction, and in general, leave the work area in clean and workmanlike condition.

1.7 DRAWINGS AND SPECIFICATIONS

- A. See Article 2 of the General Conditions.
- B. Where specific details and dimensions are not shown on the drawings, the contractor shall take measurements and make layouts as required for proper installation of mechanical work so that interference with all other work will be avoided. This includes roughing-in for fixtures and equipment as called for or inferred.

1.8 SHOP DRAWINGS AND SAMPLES

- A. Shop drawings and Samples shall be submitted in accordance with the requirements of Articles 18 & 19 of the General Conditions and as follows:
- B. Submittals shall include but not be limited to the following:
 - 1. Manufacturer's detail drawings of equipment and material.
 - 2. Descriptive literature including catalog data covering design, size, performance and capacity of material and equipment.
 - 3. Contractor's shop details for installation of material and equipment.

1.9 SUBSTITUTIONS

- A. Substitutions shall be made in accordance with the Article 16 of the General Conditions and as follows: In addition to the conditions of Article 16 the contractor shall make all required changes in the performance of any and all equipment affected by the change.

1.10 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall furnish all services as required for adequate verbal and written instructions to the Owner's operating and maintenance personnel for operation and maintenance of all equipment and systems installed.
- B. Warranties and operating instructions shall be provided in accordance with Article 32 of the General Conditions, and as follows:
- C. Materials shall be furnished in hard-back binders and shall include all manufacturer's printed instructions for equipment installation, operation and maintenance and all approved shop drawings. Hardback binders shall be similar to National Stiff Cover Ring Binders with heavy duty Tufvin cover, metal hinge and label holder and rings with open, close and lock booster.

1.11 ELECTRICAL EQUIPMENT

- A. All required electrical equipment, such as motors, starters, relays and electric or electronic controls for equipment furnished shall be installed per specifications in Division 26 - Electrical.

1.12 ALIGNMENT OF DRIVERS, DRIVES AND DRIVEN EQUIPMENT

- A. Drivers (motors and/or engines) shall be set level and aligned with equipment being driven and shall be securely fastened in place. Drivers shall be rated for a minimum of 150% of the driver horsepower and shall be provided with coupling or belt guards as required by OSHA and as directed by the engineer. All equipment requiring lubrication shall be kept in the best operating condition during performance of the work.

1.13 ACCESS TO EQUIPMENT

- A. All control devices, specialties, valves, junction boxes, pull boxes and removable panels on equipment shall be so located as to provide easy access for inspection and maintenance including removal of any interior components. Any material or equipment, such as piping, ducts, conduit, etc., that is installed without due regard to the accessibility of equipment and devices shall be relocated, offset or rerouted without cost to the Owner.

1.14 SLEEVES AND OPENINGS

A. General

1. The contractor shall locate and provide all sleeves and openings required for the execution of the design as specified. Contractor shall locate sleeves and openings as shown on the structural drawings, if shown.
2. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved in writing by the Engineer.
3. All sleeves shall be carefully and accurately set. Sleeves set in concrete construction shall be securely anchored as required to prevent movement and maintain alignment, when concrete is poured.
4. Sleeves shall be sealed to the surrounding construction using grout, plaster etc. as approved by engineer. Space between pipe and sleeve shall be sealed using approved sealants. Sealants shall be selected to maintain the fire rating of the partition. Sealant shall be finished flush with adjacent surfaces.
5. Contractor shall submit shop drawings for the sealant materials for approval by engineer.

B. Exterior Walls

1. Masonry or Concrete: All sleeves penetrating masonry or concrete walls shall be Schedule 40 black steel pipe. Sleeves shall be cut flush with both sides of wall and all burrs or sharp edges filed smooth.
2. Wood Frame: Sleeves shall not be required where pipe lines penetrate exterior wood frame walls. The piping shall be anchored to prevent all motion at the penetration location and the penetrations shall be sealed air and water tight.
3. Duct Penetration (Masonry and Wood Frame): All ducts through exterior walls shall be reinforced on both sides of wall with angle iron or galvanized sheet steel frames. Contractor shall provide lintels as required and directed by the engineer for masonry penetrations. Opening between ductwork and wall opening shall be sealed using approved sealant. Sealant shall be selected to maintain the fire rating of the separation. Where fire walls are involved, fire dampers shall be installed in accordance with UL and NFPA requirements. All steel shall be galvanized or painted. Equipment (fans, etc.) Penetrating walls shall be provided with lintels, fire dampers, etc. as specified for ducts above.

C. Interior Walls, Ceilings & Partitions

1. Masonry or Concrete: All sleeves penetrating masonry or concrete walls shall be Schedule 40 black steel pipe. Sleeves shall be cut flush with both sides of wall and all burrs or sharp edges filed smooth.
2. Drywall: All piping passing through new or existing dry way partitions or ceilings shall be sealed to the drywall and where exposed, shall be provided with chrome plated escutcheons. Piping shall be supported such that motion of piping at the point of wall penetrations is eliminated.
3. Duct Penetration (Masonry and Drywall): All ducts through interior walls, ceilings and partitions shall be reinforced on both sides of wall with angle iron or galvanized sheet steel frames. Contractor shall provide lintels as required and directed by the engineer for masonry penetrations.
4. Opening between ductwork and wall opening shall be sealed using approved sealant. Sealant shall be selected to maintain the fire rating of the separation. Where fire walls are involved, fire dampers shall be installed in accordance with UL and NFPA requirements. All steel shall be galvanized or painted. Equipment (fans, etc.) penetrating walls shall be provided with lintels, fire dampers, etc. as specified for ducts above.

D. Floors

1. Floor Sleeves:
 - a. All piping through floors shall be installed in sleeves.
 - b. Unless otherwise indicated on the structural drawings, floor sleeves shall be as follows. Sleeves in floors shall be Schedule 40 black steel pipe sleeves extending 2" above floor to serve as a water stop. Sleeves shall be sealed so as to be watertight and maintain fire rating of floor.

END OF SECTION 220000

SECTION 220050 - BASIC MECHANICAL MATERIALS AND METHODS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and the Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 22 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Field-fabricated metal and wood equipment supports.
3. Installation requirements common to equipment specification Sections.
4. Touchup painting and finishing.
5. Hangers and supports for mechanical systems piping and equipment.

- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include porches.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect pipes, tubes, flanges, fittings, and piping specialties from moisture and dirt.

- C. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 22 for special joining materials not listed below.
- B. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- C. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
 - 2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
 - 3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
 - 4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
 - 5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
 - 6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20 percent maximum lead content.

- D. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
 - E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 - F. Solvent Cements: Manufacturer's standard solvents complying with the following:
 - 1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
 - 2. Chlorinated Poly (Vinyl Chloride) (CPVC): ASTM F 493.
 - 3. Poly (Vinyl Chloride) (PVC): ASTM D 2564.
 - 4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
 - G. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- 2.3 PIPING SPECIALTIES.
- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
 - 1. Inside Diameter: Closely fit around pipe, tube, and insulation.
 - 2. Outside Diameter: Completely cover opening.
 - 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Polished chrome plate.
 - 4. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
 - 5. Cast-Iron Floor Plate: One-piece casting.
 - B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
 - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
 - D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet-Metal: 24-gage (0.70mm) or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
 - 4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
 - a. Penetrating Pipe Deflection: 5 percent without leakage.
 - b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.

- c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.
5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

2.4 HANGERS AND SUPPORTS MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.5 HANGER AND SUPPORTS MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36 (ASTM A 36M), steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 22 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install components having pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

- F. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- G. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.
- H. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- I. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.
- J. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install large enough sleeves to provide 1/4-inch (6-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6 inches (150 mm).
 - b. Steel Sheet-Metal Sleeves: For pipes 6 inches (150 mm) and larger that penetrate gypsum-board partitions.
 - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Flashing is specified in Division 7 Section "Sheet Metal Flashing and Trim."
 - 4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."
- K. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25-mm) annular clear space between pipe and sleeve for installation of mechanical seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm).
 - 2. Install cast-iron wall pipes for sleeves 6 inches (150 mm) and larger.
 - 3. Assemble and install mechanical seals according to manufacturer's printed instructions.
- L. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
- M. Verify final equipment locations for roughing in.
- N. Refer to equipment specifications in other Sections for roughing-in requirements.
- O. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
 - 1. Install unions in piping 2 inches (50 mm) and smaller adjacent to each valve and at final

- connection to each piece of equipment having a 2-inch (50-mm) or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2 inches (65 mm) and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 3. Dry Piping Systems (Gas): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems (Water): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

- A. Equipment: Standard equipment labels which generally come with the equipment.

3.4 PAINTING AND FINISHING

- A. Refer to Division 9 Section "Painting" for field painting requirements.
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.6 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

3.7 HANGER AND SUPPORT INSTALLATION

- A. General: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

- C. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- D. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.8 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.9 HANGER METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.10 HANGER ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 220050

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SECTION 220410 - PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing piping systems to a point 5 feet outside the building. Systems include the following:
 - 1. Potable water distribution, including cold- and hot-water supply.
 - 2. Drainage and vent systems, including sanitary.
 - 3. Compressed air system.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and installation requirements not specified in this Section.
 - 2. Division 22 Section "Plumbing Fixtures and Specialties" for plumbing system components.
 - 3. Division 22 Section "Valves".

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, except where indicated otherwise:
 - 1. Water Distribution Systems, Below Ground: 150 psig.
 - 2. Water Distribution Systems, Above Ground: 100 psig.
 - 3. Soil, Waste, and Vent Systems: 10-foot head of water.
 - 4. Compressed Air System: 150 psig.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for the following plumbing piping products:
 - 1. Pipe and fittings for copper tube.
 - 2. Pipe and fittings for PVC.
 - 3. Pipe and fittings for PE.
 - 4. Pipe and fittings for black steel.

1.5 QUALITY ASSURANCE

- A. Comply with the provisions of ASME B31.9 "Building Services Piping" for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: The application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems are indicated in Part 3 Article "Pipe and Fittings Applications."
- B. Hard Copper Tube: ASTM B 88, Type K and M, (ASTM B 88M, Types A, B, and C,) water tube, drawn temper.
- C. Soft Copper Tube: ASTM B 88, Types K, (ASTM B 88M, Types A and B,) water tube, annealed temper.
- D. Polyvinyl Chloride (PVC) Plastic, Pressure Pipe: ASTM D-1784, Schedule 40, plain ends.
- E. Polyvinyl Chloride (PVC) Plastic, DWV Pipe: ASTM D-2665, Schedule 40, plain ends.
- F. Polyethylene (PE), Pressure Pipe: ASTM D-1248, SDR 11, butt fusion connections.
- G. Black Steel Pipe: Schedule 40, ASTM A53, Grade B, threaded connections.

2.2 PIPE FITTINGS AND TUBE FITTINGS

- A. Wrought-Copper, Solder-Joint Pressure Fittings: ASME B16.22.
- B. Copper Unions: ASME B16.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends.
 - 1. Threaded Ends: Threads conforming to ASME B1.20.1.
- C. Polyvinyl Chloride (PVC) Plastic, DWV Pipe Fittings: ASTM D 2665, made to ASTM D 3311; socket-type; drain, waste, and vent pipe patterns.
- D. Polyvinyl Chloride (PVC) Plastic, Pressure Pipe Fittings: ASTM D-2466 for schedule 40 or 80 socket-type fittings.
- E. Polyethylene (PE), Pressure Pipe Fittings: ASTM D-1248, SDR 11, butt fusion connections.
- F. Black Steel Pipe Fittings: Malleable iron conforming to ASTM A47 and ANSI B16.3, 150 pound, threaded connections.

2.3 JOINING MATERIALS

- A. Solvent-cement, solder, brazing, and welding filler metals are specified in Division 22 Section "Basic Mechanical Materials and Methods."

2.4 VALVES

- A. Refer to Division 22 Section "Valves" for gate, globe, ball, butterfly, and check valves.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavation, trenching, and backfilling are specified in Division 31.

3.2 PREPARATION OF FOUNDATION FOR BURIED PIPING

- A. Grade trench bottom to provide smooth, firm, stable, and rock-free foundation throughout length of piping.
- B. Remove unstable, soft, and unsuitable materials at surface on which piping is to be laid and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped-sand backfill. Dig bell holes at each pipe joint to relieve bells of loads and to ensure continuous bearing of pipe barrel on foundation.

3.3 PIPE AND FITTINGS APPLICATIONS

- A. General: Use pipe, tube, fittings, and joining methods for piping systems according to the following applications.
- B. Water Distribution Piping Below Ground: Use the following:
 - 1. 2 Inches and Smaller: Soft copper tube, Type K, cast-copper-alloy solder-joint pressure fittings, and soldered joints with "lead-free" solder meeting ASTM B 32.
 - 2. Greater than 2 Inches: Hard copper tube, Type K; wrought-copper or cast-copper-alloy pressure fittings; copper unions; and solder joints with "lead-free" solder meeting ASTM B 32.
 - 3. 4 Inches and Smaller: PE pipe and fittings shall be made from P34CH polyethylene compound meeting PE3408 ASTM D-1248 requirements for Type 3, Class C, Category 5, Grade 34 material. The pipe shall have an SDR of 11 with a design working pressure of not less than 160 psi at 73.4 degrees F.
- C. Water Distribution Piping Above Ground: Use the following:
 - 1. 3-1/2 Inches and Smaller: Hard copper tube, Type M; wrought-copper or cast-copper-alloy pressure fittings; copper unions; bronze flanges; and solder joints with "lead-free" solder meeting ASTM B 32.
 - a. Fittings Option: Mechanically formed outlets, brazing filler alloy, and brazed joints.
- D. Soil, Waste, and Vent Piping Above Ground: Use the following:
 - 1. 2 to 4 Inches: Polyvinyl Chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
- E. Soil, Waste, and Vent Piping Below Ground: Use the following:
 - 1. 2 to 6 Inches: Polyvinyl Chloride (PVC) plastic Schedule 40 PVC pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
- F. Compressed Air Piping Above Ground: Use the following:

1. 1/2 to 3 Inches: Black Steel Pipe and Fittings with threaded connections.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use gate, or ball valves.
 2. Throttling Duty: Use globe, or ball valves.

3.5 PIPING INSTALLATION, GENERAL

- A. Basic piping installation requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."
- B. Install water hammer arrestor in accordance with the latest version of the International Plumbing Code. Water hammer arrestor shall be manufactured by Sioux Chief or similar and be sized in accordance with manufacturers recommendations.

3.6 SERVICE ENTRANCE PIPING

- A. Extend water distribution piping and connect to water service piping of size and in locations indicated for service entrance to building. Water service piping is specified in Division 22.
- B. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install manhole or cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer. Sanitary sewerage piping is specified in separate Section of Division 22.
- C. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

3.7 DRAINAGE AND VENT PIPING INSTALLATION

- A. Make changes in direction for drainage and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-Y-branch and 1/8-bend fittings where 2 fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90 degrees. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- B. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.
- C. Install drainage and vent piping at the following minimum slopes, except where another slope is indicated on drawings:
 1. Sanitary Building Drain: 1/4 inch per foot (1:50) (2 percent) for piping 3 inches (DN 80) and smaller; 1/8 inch per foot (1:100) (1 percent) for piping 4 inches and larger.

2. Horizontal Sanitary Drainage Piping: 1/4 inch per foot (1:50) (2 percent).
3. Vent Piping: 1/8 inch per foot (1:100) (1 percent).

3.8 INSTALLATION OF VALVES

- A. Shutoff Valves: Install shutoff valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use gate or ball valves.

3.9 HANGERS AND SUPPORTS INSTALLATION

- A. Hanger and support devices are specified in Division 22.
- B. Conform to table below for maximum spacing of supports:

<u>Pipe Material</u>	<u>Horizontal Spacing (ft)</u>	<u>Vertical Spacing (ft)</u>
Ferrous and Copper Pipe and Tubing - 1 1/2 Inches and Smaller	6	10
Ferrous and Copper Pipe and Tubing - 2 Inches and Larger	8	10
PVC Pipe - 1 1/2 Inches and Smaller	4	4
PVC Pipe - 2 Inches and Larger	6	4

- C. Pipe Attachments: Install the following:
 1. Riser Clamps: MSS Type 8 or Type 42 for vertical runs.
 2. Adjustable Steel Clevis Hangers: MSS Type 1 for individual straight horizontal runs 100 feet and less.
 3. Adjustable Roller Hangers: MSS Type 43 for individual straight horizontal runs longer than 100 feet.
 4. Spring Cushion Rolls: MSS Type 49, where indicated, for individual straight horizontal runs longer than 100 feet.
 5. Pipe Rolls: MSS Type 44 for multiple straight horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
 6. Spring Hangers: MSS Type 52 for support of base of vertical runs.
- D. Support plastic pipe and tubing not included in table according to manufacturer's recommendations.

3.10 CONNECTIONS

- A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts of sizes indicated, but not smaller than required by plumbing code to fixtures.
- B. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.
- C. Mechanical Equipment Connections: Connect hot- and cold-water supply piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection.

3.11 FIELD QUALITY CONTROL

- A. Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
2. During progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the plumbing official.
 - a. Roughing-In Inspection: Arrange for inspection of piping system before concealed or closed-in after system roughing-in and prior to setting fixtures.
 - b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
3. Reinspections: When a plumbing official finds that piping system will not pass test or inspection, make required corrections and arrange for reinspection by the plumbing official.
4. Reports: Prepare inspection reports signed by plumbing official.

B. Test water distribution piping as follows:

1. Test for leaks and defects in new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
3. Cap and subject the piping system to a static water pressure of 50 psig (345 kPa) above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

C. Inspect drainage piping as follows:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During progress of installation, notify the plumbing official having jurisdiction at least 24 hours prior to time such inspection must be made. Perform tests specified below in presence of the plumbing official.
 - a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
 - b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
3. Reinspections: Make required corrections and arrange for reinspection by plumbing official when piping system fails to pass test or inspection.
4. Reports: Prepare inspection reports signed by the plumbing official.

D. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures of authority having jurisdiction or, in absence of published procedure, as follows:

1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1 inch water column. Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.12 CLEANING

- A. Clean and disinfect water distribution piping as follows:
 1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.
 2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Valves and faucets shall be opened several times during the disinfection process. Isolate (valve off) and allow to stand for 24 hours.
 - c. The system may be flushed if residual chlorine is not less than 10 ppm. If the residual chlorine is less than 10ppm, the disinfection procedure shall be repeated.
 - d. After the sterilization process, the system shall be thoroughly flushed with clean water until the chlorine content is less than 0.1 ppm.
 - e. Water samples shall be taken in bottles furnished by the Department of Natural Resources - Environmental Quality for a complete bacteriological analysis. If water is not suitable for human consumption, the sterilization process shall be repeated until water is approved as satisfactory for use. Sterilization process shall meet requirements of the Department of Natural Resources - Environmental Quality and the Contractor shall provide all materials and labor to perform the work.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.13 COMMISSIONING

- A. Fill water systems. Check pipes to determine that they are not air bound and that system is completely full of water.

- B. Before operating systems, perform these steps:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to full open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used, clean, and ready for use.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
- E. Energize pumps and verify proper operation.

3.14 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or when work stops.
- C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water-based latex paint.
- D. Steel Pipe and Fittings: cleaned, primed, and coated with epoxy paint per Division 9.

END OF SECTION 220410

SECTION 221101 - BORING AND JACKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 - Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The pipeline will cross State Route 165 which will require installation of the carrier pipe in an encasement pipe installed by boring and/or jacking.
- B. The work included for each individual installation involves, but is not limited to, access to property, all labor, equipment, supervision, all encasement pipe and/or tunnel liner plate, excavation, dewatering, sheeting, bracing, select backfill and stabilization stone if required, any additional cost for installing the carrier pipe in the casing, enclosures, and all else necessary to provide the required installation.
- C. The OWNER has secured the necessary encroachment agreements from the Department of Transportation, and the CONTRACTOR shall secure the necessary construction permits from that agency for all crossings. Any special insurance and/or bond which may be required by the Department of Transportation shall be provided by the CONTRACTOR and included in the appropriate bid item.

1.3 QUALITY ASSURANCE

- A. Construct all highway crossings under this Section in conformance with all applicable standards of the State Department of Transportation.
- B. Welding shall conform to AWS standards for type and thickness of materials.

PART 2 – PRODUCTS

2.1 ENCASEMENT PIPE

- A. Steel Encasement Pipe shall be spiral welded or smooth wall seamless, consisting of grade "B" steel with a minimum yield strength of 35,000 PSI and manufactured in thickness no less than shown in the project plans & drawings. (ASTM A53 pipe will meet specs and wall thickness) The ends shall be beveled and prepared for field welding at the circumferential joints.
- B. Service pipe casing shall be PVC conforming to ASTM Specification D 2241, SDR 21. Joints shall be solvent welded per ASTM Specification D 3350. In special cases, Type III HDPE casing may be used in lieu of PVC with the express written consent by the ENGINEER. All HDPE service pipe casing shall be rated for a minimum of 200 psi and all joints shall be created through heat fusion welding.

2.2 CARRIER SPACERS

- A. Casing spacers shall be utilized to form a tight fit between the casing and carrier pipe. The spacers shall be made out of plastic material and approved by the ENGINEER prior to installation.

2.3 CARRIER PIPE

- A. Carrier pipe shall be PVC or other pipe material as shown on the drawings.

2.4 SIGNS

- A. The Contractor shall provide appropriate signing at all times during the construction of facilities; signs must be in place before construction begins.

2.5 CASING END SEALS

- A. The casing ends shall be sealed through the use of a neoprene boot. Wrap and banding shall not be allowed. The ENGINEER shall approve the end seal material prior to installation.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install steel pipe encasements by boring and/or jacking or by pushing the casing pipe through a bored hole. Ensure that the encasement is installed true to line and grade.
- B. The boring machine shall be designed to bore and push back or jack the casing on a controlled grade and line in a continuous operation. The boring auger shall not be greater diameter than the outside diameter of the casing. Bore progressively ahead of the advancing pipe while spoil is removed by the auger back through the pipe.
- C. Butt-weld each new section of the encasement pipe to the section previously jacked into place as the boring operation continues.
- D. Protect ends of encasement in acceptable manner to prevent the entrance of foreign materials or debris.
- E. If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe and the voids filled with 1:3 Portland cement grout at sufficient pressure to prevent settlement in the roadway.
- F. In the event an obstruction is encountered during the boring and jacking operation, notify the ENGINEER of the obstruction and obtain written authorization from the ENGINEER prior to proceeding with the premature termination of that boring.
- G. When premature termination of a boring is authorized, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland cement grout at sufficient pressure to fill all voids before moving to another boring site.
- H. Ensure that the encasement pipe is installed at the alignment and grade shown on the drawings. Report, in writing, any deviation in the alignment and grade from that shown on the drawings.
- I. Joint carrier pipe in accordance with manufacturer's specifications.
- J. Carefully secure pipe supports to each joint of carrier pipe. Supports shall be placed at each end of the casing, at each pipe bell for DIP, and at intervals not greater than 6 feet for PVC or ABS pipe. For gravity sewer the supports shall be constructed to maintain the proper slope of the line even when the casing alignment deviates from the slope shown on the drawings.

- K. Carefully push carrier pipe through encasement ensuring that the assembly is not damaged.
Ensure that the carrier pipe is installed at the alignment and grade shown on the drawings.

END OF SECTION 221101

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SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. American Water Works Association (AWWA):
 - 1. C500 Gate valves 3" – 48" for Water and Other Liquids
 - 2. C600 Hydrostatic Testing
 - 3. C651-99 Disinfecting Water mains
- C. B. American Society of Testing and Materials
 - 1. D-1784 Rigid Poly (Vinyl chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds
 - 2. D-2239 Polyethylene (PE) Plastic Pipe (SDR-PR)
 - 3. D-2241 Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)
 - 4. D-3139 Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. PA: Polyamide (nylon) plastic.
- C. PE: Polyethylene plastic.
- D. PP: Polypropylene plastic.
- E. PVC: Polyvinyl chloride plastic.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of Missouri American Water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- E. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
 - 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.9 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Flanges: ASME 16.1, Class 125, cast iron.

2.2 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D 2239, SDR No. 9; with PE compound number required to give pressure rating not less than 160 psig.
 - 1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 - 2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

- B. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 150.
 - 1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.3 PVC PIPE AND FITTINGS

- A. PVC, Schedule 80 Pipe: ASTM D 1785.
 - 1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
 - 2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

2.4 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.5 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.6 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 1. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 - 1. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, metal resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 CHECK VALVES

- A. AWWA Check Valves:
 - 1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
 - a. Standard: AWWA C508.
 - b. Pressure Rating: 175 psig.

2.9 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Meters shall be installed at locations determined by the owner and engineer, and shall be high pressure type with individual pressure reducing valves. Meter shall be $\frac{3}{4}$ " Precision, Sensus, or approved equal. Meter setter shall be single check valve Ford, Mueller, or approved equal.
- C. Displacement-Type Water Meters:
 - 1. Description: With bronze main case.
 - a. Standard: AWWA C700.
 - b. Registration: Flow in gallons.

2.10 PRESSURE-REDUCING VALVES

- A. Water Regulators:
 - 1. Standard: ASSE 1003.
 - 2. Pressure Rating: Initial pressure of 150 psig.
 - 3. Size: 1/2 to 2-1/2 NPS.>
 - 4. Design Flow Rate: 261 gpm.
 - 5. Design Inlet Pressure: 200 psig.>
 - 6. Design Outlet Pressure Setting: 60 psig.>
 - 7. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
 - 8. Valves for Booster Heater Water Supply: Include integral bypass.
 - 9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Description: All valves 2" in diameter and larger shall have flanged ends for interior service and mechanical joints for buried service unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze. All inline gate valves shall be marked using a 6' metal fence post painted blue with rust resistance non-water based paint.
2. All valves of the same type shall be from a single manufacturer. Parts for valves of the same type and size shall be interchangeable. Special tools required for re-packing or disassembling valves shall be provided. All valves shall open counter-clockwise.

2.11 RELIEF VALVES

A. Air-Release Valves:

1. Description: Air release valves shall be installed in accordance with the details as shown on approved plans. Locations of valves shall be determined in the field by the engineer. Air release valves shall be Val Matic, equivalent Singer, or approved equal. Air release valves shall be installed in a modified polyethylene molded meter box as produced by Uponor, Hersey, or approved equal. The box shall utilize an anti-settling flange and be molded as a single piece. Cost of structure for air valve containment shall be included in bid price.

2.12 BACKFLOW PREVENTERS

- A. The water system must be protected from introduction of contaminants by backflow in accordance with MoDNR Publication 10 CSR 60-11.010 Prevention of Backflow. Install MoDNR approved double check valve assembly to protect the water system.
- B. Backflow Preventer Test Kits:
1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.13 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.
- D. Meter boxes shall be ribbed 18" diameter x 30" deep Type 1, grade 2 PVC conforming to ASTM D1784, latest revision plastic box with cast iron ring and cover or approved equal.

2.14 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
 2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: 24-inch minimum diameter, unless otherwise indicated.
 3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a. Dimension: 24-inch- minimum diameter, unless otherwise indicated.
 4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.15 FIRE HYDRANTS

- A. 6" Fire Hydrants:
1. All flush hydrants shall conform to AWWA C502.
 2. All flush hydrants shall be equipped with a 6" gate valve installed on the flush hydrant lead between the hydrant and the main and will be included as part of the flush hydrant bid item. The gate valve shall be located within 6' linear feet of the hydrant. The hydrants shall be 3-way with a working class pressure of 250 psi. The hydrants shall have two hose nozzles and one 4-1/2" pumper nozzle.
 3. An independent drain shall be provided, completely draining the hydrant after use. The drain shall be activated to the open position by the closing of the hydrant valve. The drain rod shall be easily cleaned. The drain shall have a protective shield integral with the hydrant base to minimize clogging and prevent undermining.
 4. All working parts of the hydrant shall be easily removed for inspection or servicing without digging or the use of hoists or derricks or special tools. The hydrant cover and standpipe shall be removable without requiring the water to be shut off.
 5. All 6" flush hydrants shall be Mueller fabricated post type flush hydrant Model Super Centurion 250, AFC model B84B, or equal as approved by the Engineer. All flush hydrants shall conform to AWWA C502.

2.16 2" FLUSHING HYDRANTS

- A. Post-Type Flushing Hydrants:
1. All flush hydrants shall be equipped with a 2" gate valve installed on the flush hydrant lead between the hydrant and the main. The gate valve shall be located within 6' linear feet of the hydrant.
 2. An independent drain shall be provided, completely draining the hydrant after use. The drain shall be activated to the open position by the closing of the hydrant valve. The drain rod shall be easily cleaned. The drain shall have a protective shield integral with the hydrant base to minimize clogging and prevent undermining.
 3. All working parts of the hydrant shall be easily removed for inspection or servicing without digging or the use of hoists or derricks or special tools. The hydrant cover and standpipe shall be removable without requiring the water to be shut off.

4. All 2" flush hydrants shall be Mueller fabricated post type flush hydrant Model No. A – 408, Kupferle manufactured Mainguard, or equal as approved by the Engineer.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3, 2" to 6" shall be any of the following:
 1. PE, ASTM pipe; mechanical joints.
 2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
- F. Water Meter Box Water-Service Piping 2" to 6" shall be same as underground water-service piping.
- G. Underground Fire-Service-Main Piping 12" shall be any of the following:
 1. Ductile-iron, mechanical-joint fittings.
 2. PE, Class 150, fire-service pipe; molded PE fittings; and heat-fusion joints.
 3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
 4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections NPS 2 and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- G. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- I. Bury piping with depth of cover over top at least 36 inches below level of maximum frost penetration.
- J. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- K. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- L. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Heat-fused joints.
 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
 4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.
- H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Contractor shall tap main line, install corporation stop, install $\frac{3}{4}$ " polyethylene pipe from main to meter. Contractor shall provide the meter and all appurtenances necessary for a complete and functioning water service. Completed water service shall not exhibit any leakage. A two-inch thick layer of crushed stone shall be placed in the bottom of the meter box. Stone shall be MODOT Type 1 aggregate base. Pipe shall be approved for potable water usage. All work and materials to install meters and provide water to meters shall be included bid.
- C. All meter sets shall be recorded.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.12 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top above surface.

3.13 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.14 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.

3.15 FLUSHING HYDRANT INSTALLATION

- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
- B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
- C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

3.16 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.
- C. Connect water-distribution piping to interior domestic water piping.

3.17 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. After filling, lines shall be flushed at blowoffs and dead ends at a minimum velocity of 3 ft/sec. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100

joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

- C. Prepare reports of testing activities.

3.18 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

3.19 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Refer to MoDNR publication for additional disinfection requirements.
- C. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

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SECTION 221313 - SEWAGE LINES AND MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Contractor shall construct, furnish and install all earthwork, sewer lines, manholes, cleanouts etc. for a complete and operational system. All equipment shall be installed in accordance with the contract drawings and installation paragraphs of this section. Sewer shall be constructed according to standards established by the Missouri Department of Natural Resources, Division of Environmental Quality, Water Pollution Control Program and 10CSR Division 20, Chapter 8.

1.3 SUBMITTALS

- A. Product Data for all materials used in work.
- B. Shop drawings for the pre-cast concrete manholes and other structures, including frames and covers.
- C. Shop drawings for the cast-in-place concrete manholes and other structures, including frames and covers.
- D. Inspection and test reports specified in the "Field Quality Control" Article.

PART 2 - PRODUCTS

2.1 GRAVITY SEWER PIPE

- A. Sewer pipe below grade, down stream of the first manhole and beyond the building walls shall be polyvinyl chloride (PVC) gravity sewer pipe as specified below.
- B. PVC underground gravity sewer pipe and fittings shall have gasket joints with an integral bell which is a homogeneous part of the pipe. The pipe and fittings shall meet or exceed ASTM D-3034 with SDR 35. The pipe and fitting compound shall meet or exceed ASTM D-1784. Joints shall conform to ASTM D-3212. Gaskets shall conform to ASTM D-1869. Gaskets shall be molded from a high grade, properly vulcanized, elastomeric compound consisting of a basic natural or synthetic rubber. Lubricant shall be suitable for lubricating the joint components. It shall have no deteriorating effect on the gasket or pipe material. Installation shall be as recommended by the manufacturer.

2.2 MANHOLES

- A. Normal-Traffic Pre-cast Concrete Manholes: ASTM C 478, pre-cast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of pre-cast concrete sections or add concrete to base section, as required to prevent flotation.

3. Base Section: 12-inch minimum thickness for floor slab and 8-inch minimum thickness for walls and base riser section, and having base section with integral floor.
4. Riser Sections: 8-inch minimum thickness and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Gaskets: ASTM C 443, rubber.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.
8. Steps: American Step Company or Project Manager approved equal, ASTM C 478 epoxy coated steel steps. Omit steps for manholes less than 36 inches deep. Include a width that allows a worker to place both feet on one step and is designed to prevent lateral slippage off the step. Cast steps in base, riser, and top section sidewalls at 12- to 16-inch (300- to 400-mm) intervals.
9. Pipe Connectors: Provide "A-LOC", or Project Manager approved equal, cast-in-place manhole pipe connections, ASTM C 923, resilient, of size required, for each pipe connecting to base section.
10. Invert: Formed concrete invert as shown on Plans.
11. Manhole Lid and Frame: Unless noted otherwise, Neenah heavy duty manhole frame and lid, Model R-1706-1S or Project Manager approved equal.

2.3 PVC CLEANOUTS

- A. Sewer Pipe Fitting Cleanout: Made of Type 1 PVC material, 4" diameter, meets ASTM D-3034 and ASTM D-2729 standards with Styrene D-2852.
- B. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 SEWER INSTALLATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
- B. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water or under unsuitable weather or trench conditions.
- C. Pipe shall be kept clean by means approved by the Project Manager during and after laying the pipe.
- D. Blocking shall not be used to support the pipe or joint.

3.2 MANHOLE INSTALLATION

- A. Manhole shall be set with base and top at the elevations shown on the drawings. Contractor shall provide a minimum of 6" granular bedding under manhole base. Rings shall be set with the spigot end up. Rings and castings shall be set using pre-mixed sewer joint mastic compound, as approved by the Project Manager. Concrete used for invert channels etc. shall be steel-troweled to produce a dense, smooth surface.

3.3 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use PVC fittings in sewer pipes at branches for cleanouts, and use PVC soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Heavy-Duty, top-loading classification cleanouts in all areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.4 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and whenever work stops.
 - 3. Flush piping between manholes and other structures, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 95 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
 - 4. Submit separate reports for each test.

END OF SECTION 221313

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SECTION 224400 - PLUMBING FIXTURES AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing fixtures and trim, faucets, other fittings, and related components.
- B. This Section includes plumbing specialties for water distribution systems; soil, waste, and vent systems..

1.3 DEFINITIONS

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working pressure ratings, except where otherwise indicated:
 - 1. Water Distribution Systems, Below Ground: 150 psig (1035 kPa).
 - 2. Water Distribution Systems, Above Ground: 125 psig (860 kPa).
 - 3. Soil, Waste, and Vent Systems: 10 foot head of water (30 kPa).
 - 4. Sanitary Sewage Systems: 75 psig (520 kPa).

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- C. Submit product data including rated capacities of selected models and weights (shipping, installation, and operation). Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:
 - 1. Cleanouts, cover plates, and access panels.
 - 2. Vent caps, vent terminals, and roof flashing assemblies.
 - 3. Floor drains, and trench drains.
 - 4. Sleeve penetration systems.

- D. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.
- B. Regulatory Requirements: Comply with requirements of Public Law 101-336, "Americans with Disabilities Act" regarding plumbing fixtures for physically handicapped people.
- C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- E. Design Concept: The Drawings indicate capacities, sizes, and dimensional requirements of system components. Components having equal performance characteristics that deviate from the indicated size and dimensions may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality of products is on the Contractor. Refer to General Conditions, Article 16, for substitutions.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in dry location.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Sleeve Penetration Systems:
 - a. Proset Systems, Inc.

2.2 HOSE BIBBS

- A. Exterior Wall Hydrants (HB-1) - Hydrant shall be Wade W-8620 series, or equal. Hydrant shall be cast bronze non-freeze type with 3/4" NPT female inlet and 3/4" HPT outlet. Provide hydrant with polished bronze face, backflow preventer, pressure relief valve, and bronze casting. The hydrant shall penetrate wall thickness as required and shall be furnished with a wall clamp. Exterior hydrants shall be mounted between 2 feet and 3 feet above finished grade as directed by engineer.
- B. Interior Wall Hydrants (HB-2) - Hydrant shall be a Watts SC-4 or similar.

2.3 CLEANOUTS

- A. Floor cleanouts shall be Wade Series W-6000, or equal, with a coated cast iron body, spigot connection with PVC tapered plug, adjustable housing with a secured satin finish bronze top, sized as shown on drawings.

2.4 FLOOR DRAIN

- A. General: Size outlets as indicated on Product Data Sheet or drawings.
- B. Floor Drains: FD-1 Floor drain shall be carefully installed and set level at proper elevation. Floor drains shall be Wade W-1100 series, or equal, with adjustable 6" diameter standard strainer with satin nickel bronze top. Drain body shall be inside caulk connection or "Ty Seal" at contractors option. Floor drain shall be installed with deep seal "P" trap, sized as shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
 - 1. Carriers: For wall-hanging water closets and fixtures supported from wall construction.
 - 2. Chair Carriers: For wall-hanging urinals, lavatories, sinks, drinking fountains, and electric water coolers.
 - 3. Heavy-Duty Chair Carriers: For accessible urinals, lavatories, and other fixtures where indicated.
 - 4. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
 - 5. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch (38-by-89-mm or 38-by-140-mm) fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch (6.35-by-152.4-mm) steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.

3.3 PLUMBING FIXTURE INSTALLATION

- A. Assemble plumbing fixtures and trim, fittings, faucets, and other components level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- B. Install Handicapped Fixtures in accordance with the Americans with Disabilities Act (ADA). Mounting heights of fixtures, flush valves, traps, etc. shall comply with ADA.
- C. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.

- D. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- E. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- F. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- G. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- H. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant according to sealing requirements specified in Division 7 Section "Joint Sealants." Match sealant color to fixture color.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.
- B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for fitting sizes and connection requirements for each plumbing fixture.
- C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.

3.5 ADJUSTING AND CLEANING

- A. Operate and adjust all faucets, flush valves, disposers, etc.. Replace damaged or malfunctioning equipment. Replace damaged or malfunctioning equipment.
- B. Clean all fixtures, fittings, strainers, etc. using manufacturers recommended methods and products.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

3.7 WATER CLOSET SCHEDULE

- A. Accessible Water Closet WC-1: Where plumbing fixtures of this designation are indicated, provide products complying with the following:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Vitreous-China Water Closet:
 - a. Cadet 17H EL 1.6/PA model 2168.100, American Standard, Inc.

3. Toilet Seat:
 - a. #95, Olsonite Corp.
4. Fixture Color: White.
5. Bowl Type and Operation: Elongated, siphon jet.
6. Mounting and Outlet: Floor mounted, floor outlet.
7. Fixture Bolt Caps: White, china.
8. Rim Height: 17.5 to 18 inches (445 to 457 mm).
9. Tank Trim: Flushometer Tank.
10. Accessible-Fixture Tank: Modified as required for lever mounting on side of tank that will be on wide side of fixture compartment.
11. Design Water Consumption: 1.6 gal. (6 L) per flushing cycle.
12. Toilet Seat: Solid-plastic, water-closet seat with bumpers and hardware, compatible with water closet and as follows:
 - a. Color: White.
 - b. Class: Commercial, Standard.
 - c. Size: Elongated.
 - d. Pattern: Open front without cover.

3.8 LAVATORY SCHEDULE

- A. Accessible Lavatory L-1: Where plumbing fixtures of this designation are indicated, provide products complying with the following:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Vitreous-China Lavatory:
 - a. Declyn #0321.075, American Standard, Inc.
 3. Faucet:
 - a. #7401.172H, American Standard, Inc.
 4. Fixture Color: White.
 5. Fixture Dimensions: 18"x17"
 6. Fixture Faucet-Hole Spacing: 3 holes, centered and 2 inches (51 mm) each side of center.
 7. Mounting: Wall Hung.
 8. Rim Height: 34 inches (864 mm).
 9. Faucet Construction: Center set with inlets on 4-inch (102-mm) centers,
 10. Faucet Valve Operation: Manual, ON-OFF.
 11. Faucet Mounting Position: Centered on fixture.
 12. Faucet Components: Include the following:
 - a. Accessible-Fixture Operation: Manual.
 - b. Handle(s): Extended, single-lever toggle.
 - c. Spout: Integral with body.
 - d. Spout-Outlet, Flow-Control Fitting: ½ gpm (0.032 L/s).
 13. Supply Inlets: 3/8-inch NPS (DN10), brass pipe or copper tubing.
 14. Supply Stops: Manufacturer's standard brass, angle or straight, compression, wheel-handle type, same size as supply inlet and with outlet matching supply riser.
 15. Drain: Grid strainer with 1-1/4-inch NPS (DN32) tailpiece.

3.9 SERVICE SINK SCHEDULE

- A. Service Sink SS-1: Where plumbing fixtures of this designation are indicated, provide products complying with the following:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Enameled cast iron Floor-Mounting Service Sink:
 - a. No. K-6718, Kohler

3. Faucet:
 - a. No. 8344.111, American Standard, Inc.
4. Fixture Dimensions: 22" by 18"
5. Mounting: Trap standard and wall bracket.
6. Faucet: Widespread, cast brass, chrome finish, with supplies on 15-inch centers.
7. Faucet Mounting: Above back.
8. Faucet Components: Include the following:
 - a. Finish: Polished chrome.
 - b. Handles: Dual lever or 4 arm.
 - c. Supply Stops: Integral, in shanks.
 - d. Spout: With integral vacuum breaker, pail hook, and hose-thread outlet.
 - e. Wall Brace: Assembly with wall bracket and support to faucet spout.
9. Trap Standard: 2-inch NPS (DN50) with grid strainer, enameled interior, cleanout, floor support, and pipe waste to wall.
10. Drain: 2-inch NPS (DN50) with grid strainer.
11. P-Trap: 2-inch NPS (DN50) drainage piping.
12. Supplies: ½-inch NPS (DN15) copper tubing (with ball, gate, or globe valve).

3.10 WATER HEATER SCHEDULE

- A. Water Heater WH-1: Where plumbing fixtures of this designation are indicated, provide products as shown on the drawings or similar. Install on a shelf at height as indicated on the drawings.

3.11 PIPING SPECIALTY INSTALLATION

- A. Install cleanouts in above-ground piping and building drain piping as indicated, and where not indicated, according to the following:
 1. Size same as drainage piping up to 4 inches (DN 100) size. Use 4 inches (DN 100) size for larger drainage piping except where larger size cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet (15 m) for piping 4 inches (DN 100) and smaller and 100 feet (30 m) for larger piping.
 4. Locate at base of each vertical soil or waste stack.
- B. Install cleanout deck plates (covers), of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
- C. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- D. Install flashing flange and clamping device with each stack and cleanout passing through floors having waterproof membrane.

3.12 FLOOR DRAIN INSTALLATION

- A. Install floor drains according to manufacturer's written instructions, in locations indicated.
- B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with floor.
- C. Set drain elevation depressed below finished slab elevation as shown on structural drawings. If not shown on structural drawings, set elevation to provide proper floor slope to drain as follows:
 1. 60 inches (1500 mm) Drain Area Radius: ½ inch (13 mm) depression.
 2. 10 Foot (3000 mm) Drain Area Radius: ¾ inch (19 mm) depression.

3. 15 Foot (4500 mm) Drain Area Radius: 1 inch (25 mm) depression.
4. 20 Foot (6000 mm) Drain Area Radius: 1-1/4 inches (32 mm) depression.
5. 25 Foot (7500 mm) Drain Area Radius: 1-1/2 inches (40 mm) depression.

- D. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- E. Position drains for easy accessibility and maintenance.

3.13 CONNECTIONS

- A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts to fixtures of sizes indicated, but not smaller than required by plumbing code.
- B. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but not smaller than required by plumbing code.
- C. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.14 COMMISSIONING

- A. Preparation: Perform the following checks before start-up:
 1. Systems tests are complete.
 2. Damaged and defective specialties and accessories have been replaced or repaired.
 3. There is clear space for servicing of specialties.
- B. Before operating systems, perform these steps:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open valves to full open position.
 3. Verify drainage and vent piping are clear of obstructions. Flush with water until clear.

3.15 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or when work stops.

END OF SECTION 224400

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SECTION 230000 - GENERAL REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

- A. This work shall include all plant, labor, material, and equipment as required to furnish and install mechanical work as shown on the drawings and as hereinafter specified. All plant, labor, material and equipment not shown on the drawings and not specified but necessary and incidental to provide first class and complete installations of mechanical work shall be included in this contract.
- B. All licenses and permits required for the performance of this work shall be included in this contract. All equipment under this division shall be installed under competent supervisory service furnished by the Contractor and where necessary shall include services of special erection and operating engineers.

1.3 MISCELLANEOUS CONDITIONS

- A. All installed materials and equipment shall be new and of the best quality and design, and shall be free from defects and imperfections.
- B. All work shall be performed in accordance with the requirements Article 5 of the General Conditions (Compliance with Laws, Regulations and Inspections), and as specified below.

All work shall be in accordance with all local codes and ordinances including the latest requirements of the Underwriters Laboratories, Inc. (UL), the National Fire Protection Association (NFPA), the International Mechanical Code and the International Plumbing Code. Laws, codes and ordinances conflicting with specifications and drawings shall govern, unless exceeded by specifications and drawings in quality or quantity.

- C. Contractor shall be responsible for coordinating this work with the work of other trades on the project including responsibility for all material and equipment deliveries and installation in a manner so as to prevent delay in construction schedule.
- D. Acceptance of the work shall be subject to the condition that all systems, equipment, apparatus and appliances included in the work shall operate and perform as designed and selected with respect to efficiency, capacity and quietness. Acceptance of the work shall further be subject to the conditions that any time within one year of final approval date any defective part of the work resulting from faulty workmanship or material shall be immediately amended, repaired, or replaced without additional cost to the Owner.

1.4 INSPECTION OF AREA

- A. The Contractor shall be responsible for field inspection of the area before preparing his bid.

1.5 VARIATION FROM SPECIFICATIONS

- A. Variations from the specifications will be considered, provided attention is drawn to such variations and details given for the variations. The Owner reserves the right to reject any and all variations or to accept the variation which it deems most suitable without recourse.

1.6 CLEANING UP

- A. The Contractor shall remove from the Owner's property all temporary structures, rubbish and waste material resulting from the construction, and in general, leave the work area in clean and workmanlike condition.

1.7 DRAWINGS AND SPECIFICATIONS

- A. See Article 2 of the General Conditions.
- B. Where specific details and dimensions are not shown on the drawings, the contractor shall take measurements and make layouts as required for proper installation of mechanical work so that interference with all other work will be avoided. This includes roughing-in for fixtures and equipment as called for or inferred.

1.8 SHOP DRAWINGS AND SAMPLES

- A. Shop drawings and Samples shall be submitted in accordance with the requirements of Articles 18 & 19 of the General Conditions and as follows:
- B. Submittals shall include but not be limited to the following:
 - 1. Manufacturer's detail drawings of equipment and material.
 - 2. Descriptive literature including catalog data covering design, size, performance and capacity of material and equipment.
 - 3. Contractor's shop details for installation of material and equipment.

1.9 SUBSTITUTIONS

- A. Substitutions shall be made in accordance with the Article 16 of the General Conditions and as follows: In addition to the conditions of Article 16 the contractor shall make all required changes in the performance of any and all equipment affected by the change.

1.10 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall furnish all services as required for adequate verbal and written instructions to the Owner's operating and maintenance personnel for operation and maintenance of all equipment and systems installed.
- B. Warranties and operating instructions shall be provided in accordance with Article 32 of the General Conditions, and as follows:
- C. Materials shall be furnished in hard-back binders and shall include all manufacturer's printed instructions for equipment installation, operation and maintenance and all approved shop drawings. Hardback binders shall be similar to National Stiff Cover Ring Binders with heavy duty Tufvin cover, metal hinge and label holder and rings with open, close and lock booster.

1.11 ELECTRICAL EQUIPMENT

- A. All required electrical equipment, such as motors, starters, relays and electric or electronic controls for equipment furnished shall be installed per specifications in Division 26 - Electrical Work.

1.12 ALIGNMENT OF DRIVERS, DRIVES AND DRIVEN EQUIPMENT

- A. Drivers (motors and/or engines) shall be set level and aligned with equipment being driven and shall be securely fastened in place. Drivers shall be rated for a minimum of 150% of the driver horsepower and shall be provided with coupling or belt guards as required by OSHA and as directed by the engineer.

All equipment requiring lubrication shall be kept in the best operating condition during performance of the work.

1.13 ACCESS TO EQUIPMENT

- A. All control devices, specialties, valves, junction boxes, pull boxes and removable panels on equipment shall be so located as to provide easy access for inspection and maintenance including removal of any interior components. Any material or equipment, such as piping, ducts, conduit, etc., that is installed without due regard to the accessibility of equipment and devices shall be relocated, offset or rerouted without cost to the Owner.

1.14 SLEEVES AND OPENINGS

A. General

The contractor shall locate and provide all sleeves and openings required for the execution of the design as specified. Contractor shall locate sleeves and openings as shown on the structural drawings, if shown.

No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved in writing by the Engineer.

All sleeves shall be carefully and accurately set. Sleeves set in concrete construction shall be securely anchored as required to prevent movement and maintain alignment, when concrete is poured.

Sleeves shall be sealed to the surrounding construction using grout, plaster etc. as approved by engineer. Space between pipe and sleeve shall be sealed using approved sealants. Sealants shall be selected to maintain the fire rating of the partition. Sealant shall be finished flush with adjacent surfaces.

Contractor shall submit shop drawings for the sealant materials for approval by engineer.

B. Exterior Walls

1. Masonry or Concrete: All sleeves penetrating masonry or concrete walls shall be Schedule 40 black steel pipe. Sleeves shall be cut flush with both sides of wall and all burrs or sharp edges filed smooth.
2. Wood Frame: Sleeves shall not be required where pipe lines penetrate exterior wood frame walls. The piping shall be anchored to prevent all motion at the penetration location and the penetrations shall be sealed air and water tight.
3. Duct Penetration (Masonry and Wood Frame): All ducts through exterior walls shall be reinforced on both sides of wall with angle iron or galvanized sheet steel frames. Contractor shall provide lintels as required and directed by the engineer for masonry penetrations. Opening between ductwork and wall opening shall be sealed using approved sealant. Sealant shall be selected to maintain the fire rating of the separation. Where fire walls are involved, fire dampers shall be installed in accordance with UL and NFPA requirements. All steel shall be galvanized or painted. Equipment (fans, etc.) Penetrating walls shall be provided with lintels, fire dampers, etc. as specified for ducts above.

C. Interior Walls, Ceilings & Partitions

1. Masonry or Concrete: All sleeves penetrating masonry or concrete walls shall be Schedule 40 black steel pipe. Sleeves shall be cut flush with both sides of wall and all burrs or sharp edges filed smooth.
2. Drywall: All piping passing through new or existing dry way partitions or ceilings shall be sealed to the drywall and where exposed, shall be provided with chrome plated escutcheons. Piping shall be supported such that motion of piping at the point of wall penetrations is eliminated.
3. Duct Penetration (Masonry and Drywall): All ducts through interior walls, ceilings and partitions shall be reinforced on both sides of wall with angle iron or galvanized sheet steel frames. Contractor shall provide lintels as required and directed by the engineer for masonry penetrations.

Opening between ductwork and wall opening shall be sealed using approved sealant. Sealant shall be selected to maintain the fire rating of the separation. Where fire walls are involved, fire dampers shall be installed in accordance with UL and NFPA requirements. All steel shall be galvanized or painted. Equipment (fans, etc.) penetrating walls shall be provided with lintels, fire dampers, etc. as specified for ducts above.

D. Floors

1. Floor Sleeves:
 - a. All piping through floors shall be installed in sleeves.
 - b. Unless otherwise indicated on the structural drawings, floor sleeves shall be as follows. Sleeves in floors shall be Schedule 40 black steel pipe sleeves extending 2" above floor to serve as a water stop. Sleeves shall be sealed so as to be watertight and maintain fire rating of floor.

END OF SECTION 230000

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and the Special Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Equipment nameplate data requirements.
 - 2. Nonshrink grout for equipment installations.
 - 3. Field-fabricated metal and wood equipment supports.
 - 4. Installation requirements common to equipment specification Sections.
 - 5. Cutting and patching.
 - 6. Touchup painting and finishing.
 - 7. Hangers and supports for mechanical systems piping and equipment.

- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include porches.
- D. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for following piping specialties:

1. Mechanical sleeve seals.
 2. Identification materials and devices.
- C. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- D. Product data for each type of hanger and support.

1.6 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: An accessible and visible location.

- C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.

2.2 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.50-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory-packaged.
 - 4. Water Potable.

2.3 HANGERS AND SUPPORTS MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.4 HANGER AND SUPPORTS MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36 (ASTM A 36M), steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.2 LABELING AND IDENTIFYING

- A. Equipment: Standard equipment labels which generally come with the equipment.

3.3 PAINTING AND FINISHING

- A. Refer to Division 9 Section "Painting" for field painting requirements.
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.5 CUTTING AND PATCHING

- A. General: No structural members, load-bearing walls or footings shall be cut without first obtaining written permission from the Engineer. All openings not provided by sleeves and framed openings shall be cut by the contractor, at no additional cost to the owner.
 - 1. All openings for pipe in masonry materials shall be core drilled.
 - 2. Contractor shall investigate by use of magnetic detection instruments, field measurement or other approved means to locate any concealed piping or conduit prior to cutting. Should any active piping, conduit or wire be damaged the contractor shall restore same immediately, at no cost to the owner.
 - 3. Openings shall be cut no larger than required. The contractor shall coordinate between the trades requiring the cutting and the trades responsible for the finish work when cutting surfaces that are difficult or costly to replace, to develop a method of cutting. Contractor shall subcontract work to a contractor with expertise in this type of work, if required.
- B. Patching and Finishing
 - 1. Patching: The contractor shall patch the opening with approved non-shrink materials. Patching material shall be finished smooth with the adjacent surface, prior to applying final finish. Contractor shall submit shop drawings for patching materials for approval by engineer.
 - 2. Finishing: When finished surfaces are cut the final finish shall match the finish that existed prior to cutting. Contractor shall be totally responsible for the quality of finish work and shall make any corrections required to maintain quality of finish to match existing. Contractor shall subcontract work to a contractor with expertise in this type of work, if required.

3.6 GROUTING

- A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.

- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

3.7 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

3.9 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.10 HANGER METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.11 HANGER ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 230500

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SECTION 230762 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Propeller unit heaters with electric-resistance heating coils.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Airtherm; a Mestek Company.
 - 2. Engineered Air Ltd.
 - 3. McQuay International.
 - 4. Rosemex Products.
 - 5. Ruffneck Heaters; a division of Lexa Corporation.
 - 6. Trane.
 - 7. QMark.
 - 8. Markel.
- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Comply with UL 823.
- E. Cabinet: Removable panels for maintenance access to controls.
- F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

- H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- I. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F (288 deg C) at any point during normal operation.
 - 1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.
- J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- K. Fan Motors: Comply with requirements in 230000.
 - 1. Motor Type: Permanently lubricated.
- L. Control Devices:
 - 1. Wall-mounted programmable 5+2 day thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters level and plumb.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

- 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.
- 3.5 ADJUSTING
 - A. Adjust initial temperature set points.
- 3.6 DEMONSTRATION
 - A. Train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 230762

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SECTION 230838 - POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal ventilators.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes.
 - 5. Dampers, including housings, linkages, and operators.
- B. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aerovent; a Twin City Fan Company
 - 2. American Coolair Corp.
 - 3. Ammerman; General Resource Corp.
 - 4. Breidert Air Products.
 - 5. Broan Mfg. Co., Inc.
 - 6. Carnes Company HVAC.
 - 7. Central Blower Co.
 - 8. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
 - 9. Delhi Industries Inc.
 - 10. Greenheck.
 - 11. Hartzell Fan, Inc.
 - 12. JencoFan; Div. of Breidert Air Products.
 - 13. Loren Cook Company.
 - 14. NuTone Inc.
 - 15. Penn Ventilation.
 - 16. Quietaire Corporation.
- B. Description: Direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Accessories:
 - 1. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 2. Dampers: Counterbalanced, parallel-blade, backdraft dampers; factory set to close when fan stops.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Section 230000.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Adjust damper linkages for proper damper operation.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.

END OF SECTION 230838

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways.
3. Sleeve seals.
4. Supporting Devices
5. Grout.
6. Equipment for utility company's electric metering.
7. Concrete bases
8. Touchup paint
9. Common electrical installation requirements.

1.3 SUBMITTALS

- A. Product Data: For all items.

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 1. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.3 SUPPORTING DEVICES

- A. Material: Cold formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal items for outdoor: Hot-dip galvanized steel.
- C. Channel Supports: Hot-dip galvanized steel, Unistrut P1000 series or equal.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

2.4 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Contractor shall check electrical phasing and phase rotation at the existing panels prior to disconnecting existing circuits. When reconnecting existing circuits, the Contractor shall insure that phasing and phase rotation matches the original installation.
- B. Where circuits require more than one conductor per phase, the Contractor shall take steps (such as cutting all conductors for each phase to the same length) to prevent unequal loading on conductors.
- C. Conduit size shall meet or exceed the requirements of the National Electrical Code for the wiring installed within, conduits shall not be smaller than ¾".

- D. All wiring shall be encased within a metallic raceway system unless indicated otherwise. Flexible metal conduit and liquid tight flexible metal conduit shall not exceed the following lengths:
 - 1. Motor Terminations: Three (3) feet maximum length.
 - 2. Pre-Engineered Equipment: Three (3) feet maximum length
 - 3. Light Fixture: Six (6) feet maximum length.
 - E. The Contractor shall provide and install branch circuit and feeder circuit identification using a typed identification card at each panelboard.
 - F. The Contractor shall provide and install Arc Flash Warning Signs and Danger Electrical Shock Hazard on the exterior of all service disconnects, panelboards, and transfer switches if not provided by the Manufacturer. Contractor shall also install Danger Electrical Shock Hazard signs on all enclosures.
 - G. The Contractor shall provide and install an engraved label on the Service Entrance Disconnect indicating service disconnect.
 - H. No splicing or joints shall be permitted in feeder, only in branch circuits at outlet boxes and junction boxes will splices be allowed. Solderless compression type connectors or twist-on (wire nut) connectors shall be used when making splices. All compression type splices shall be insulated with cold shrink insulation, and twist on splices shall be taped with vinyl electrical tape.
 - I. All wiring and existing (reconnected) electrical equipment and lights shall be grounded in accordance with the NEC. The equipment grounding conductor shall be copper wire. Metallic conduit shall be installed to form a continuous ground path, with the copper equipment grounding installed. Other types of equipment grounding conductors (such as water pipes) shall not be used.
 - J. Contractor shall coordinate all power outages with the Owner's Representative.
 - K. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
 - L. Right of Way: Give to raceways and piping systems installed at a required slope.
 - M. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
 - N. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
 - O. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.
 - B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- C. **Fire-Rated Assemblies:** Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. **Interior Penetrations of Non-Fire-Rated Walls and Floors:** Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- I. **Roof-Penetration Sleeves:** Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- J. **Aboveground, Exterior-Wall Penetrations:** Seal penetrations using steel pipe sleeves and mechanical sleeve seals.
- K. **Underground, Exterior-Wall Penetrations:** Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. **Damp Locations Indoors and Outdoors:** Use hot-dip galvanized U-channel system components for support of all equipment on walls with the exception of receptacles and switches. Use hot-dip galvanized U-channel system to support light fixtures.
- B. **Support Clamps for PVC Raceways:** Click type clamp systems
- C. **Selection of Supports:** Comply with manufacturer's written instructions.
- D. **Strength of Supports:** Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200 lb design load.

3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze or bracket type hangers.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Install 1/4 inch diameter or larger threaded steel hanger rods, unless otherwise indicated.

- F. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- G. Simultaneously install vertical conductor supports with conductors.
- H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite side of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers and other devices unless components are mounted directly to structural elements of adequate strength.
- J. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Light Steel: Sheet metal screws.
 - 7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 CUTTING AND PATCHING

- A. Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trade involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.6 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electrical demolition.
 - 6. Cutting and patching for electrical construction.
 - 7. Touchup painting.

3.7 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings and devices, inspect exposed finish. Remove burrs, dirt, paint spots and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-dieneterpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, but not limited to the following:
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Senator Wire & Cable Company.
 - 4. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with THHN/THWN-2.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper #12 minimum size. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Use spade connectors if stranded cables.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Branch circuits: Type THHN/THWN-2, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- E. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
- F. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.
- G. Communications Cables: in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of spare cable.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- B. Extend sleeves installed in floors 2 inches above finished floor level.
- C. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding systems, including the following:
 - 1. Ground rods.
- C. Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Conductor: As required by the latest edition of the National Electric Code, stranded conductor.
- C. Grounding Bus: Rectangular bars of annealed copper.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Use exothermic-welding kits for all underground connections of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad 3/4" by 120 inches.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. #6 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connection.
 - 3. Connections to Structural Steel: Bolted connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with all circuits including the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Flexible raceway runs.
 - 6. Armored and metal-clad cable runs.
 - 7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least two-rod length from each other in a triangular array, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations below grade.

END OF SECTION 260526

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:

1.3 DEFINITIONS

- A. ENT: Electrical nonmetallic tubing.
- B. LFMC: Liquidtight flexible metal conduit.
- C. RNC: Rigid nonmetallic conduit.
- D. EMT: Electrical metallic tubing.
- E. RMC: Rigid metallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes and hinged-cover enclosures.
- B. Source quality-control test reports.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, but not limited to the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflec Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight): NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel compression type.
- F. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers: Subject to compliance with requirements, but not limited to the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; a Hubbell Company.
 12. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, but not limited to the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, aluminum, with gasketed cover.

2.4 PULLING LUBRICANTS:

- A. Manufacturer:

1. Polywater.

2.5 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit from and including sweep below grade.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Underground Conduit: RNC, Type EPC-40 PVC, direct buried. 90° bends underground and Sweeps underground shall be rigid steel.
 4. Connection to Vibrating LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R; outlets – cast aluminum w/gasketed cover.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed or concealed: EMT with compression fittings.
 2. Concealed in ceilings and interior walls and partitions: EMT with compression fittings.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

4. Damp or Wet Locations: rigid steel conduit.
 5. Boxes and Enclosures: Cast aluminum, w/gasketed cover.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. All 90 degree bends of raceways installed underground shall have rigid steel sweep elbows and risers.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- E. Install no more than the equivalent of four 90-degree bends in any conduit run.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- G. Do not install raceways in concrete slabs.
- H. Raceways below Slabs: Install with at least 2" of gravel over conduit below slabs. Raceway shall not be placed in slabs.
1. All conduits below slabs shall be PVC schedule 40 except sweep and riser shall be rigid steel.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- L. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Buried Conduit:

1. Underground conduits shall be buried a minimum of 2'-0" below grade to top of conduit, unless indicated otherwise.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured rigid steel conduit elbows for sweep and riser.
5. Warning tape: install warning tape 6-8" below grade.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install.
- B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- C. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- D. Extend sleeves installed in floors 2 inches above finished floor level.
- E. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials.

3.5 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- B. CLEANING
 1. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 260533

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SECTION 260750 - VOICE AND DATA COMMUNICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. IDC: Insulation displacement connector.
- C. LAN: Local area network.
- D. PVC: Polyvinyl chloride.
- E. STP: Shielded twisted pair.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: Include data on features, ratings, and performance for each component which is different than those listed on the drawings.
- B. Shop Drawings: Include dimensioned plan and elevation views for each type of termination device and mounting rack.
- C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.
- D. Product Certificates: For each type of cable, connector, and terminal equipment.
- E. Qualification Data: Contractor shall have a minimum of 3 years experience installing and testing structured cabling systems of this nature.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Contractor shall have a minimum of 3 years experience installing and testing structured cabling systems. Furnish a list of previous installations of this type. The list shall include names and telephone numbers of Owner and Consulting Engineer for projects of similar size. All installers assigned by the Contractor to this project shall have factory certification that they are qualified to install and test the provided product.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of voice and data communication cabling with Owner's telecommunications and LAN Representative. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner's Representative to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (provide data on features, ratings, and performance for each component which is different than those listed on the drawings):

1. Cable:
 - a. Belden Inc.; Electronics Division.
 - b. Berk-Tek; an Alcatel Company.
 - c. Lucent Technologies; Global Service Provider.
 - d. Mohawk/CDT; a division of Cable Design Technologies.
 - e. Superior Essex; Superior Telecommunications Inc.
2. Distribution Racks
 - a. Chatsworth
 - b. Ortronics
 - c. Southwest Data Products
 - d. Hubbell

2.2 SYSTEM REQUIREMENTS

- A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

2.3 MOUNTING ELEMENTS

- A. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes."
- B. Backboards: 3/4-inch, AC grade, fire-retardant-treated plywood.
- C. Distribution Racks: As specified on drawings (provide data on features, ratings, and performance for each component which is different than those listed on the drawings).

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

- A. Cables, Cable Connectors, Termination Panel and Workstation Outlets: As specified on drawings (provide data on features, ratings, and performance for each component which is different than those listed on the drawings or specified in the specifications).
- B. Conductors: Solid copper, cable shall have a blue outer jacket.
- C. UTP Voice and Data Cable: Comply with ANSI/TIA/EIA-568-B.2-1. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 23 AWG, color-coded. Listed as complying with Category 6e-plus capable of supporting no less than 250 Mhz.
 - 1. Superior Essex NextGain Category 6eX Cable:
 - a. Superior Cat. #54-272-2A blue in Workshop.
- D. Patch Panels:
 - 1. Terminate all horizontal cable runs in rack-mounted 24 and 48 port Category 6e-plus-rated universal Type 110 data patch panels. Cables shall be terminated using the T568B color-coding scheme. Mount patch panel in upper 1/3 of rack.
 - 2. Leviton eXtreme 6+ Universal Patch Panel
 - a. Leviton Cat.#69586-U24 24 Port Unit in Workshop. Substitutions will not be permitted.

2.5 WORKSTATION OUTLETS

- A. All horizontal cables shall be terminated to Category 6e-plus-rated RJ-45 outlets using color-coded scheme T568B. Outlets shall be orange. Contractor shall leave 6 feet of service loop at equipment cabinet.
 - 1. Leviton eXtreme 6+ QuickPort Snap-in connectors.
 - a. Cat. #61110-RO6 (orange). Substitutions will not be permitted.
 - 2. Leviton Faceplate w/Designation Window
 - a. Cat. #41080-2IP 2-port Plate, ivory. Substitutions will not be permitted.

2.6 WALL-MOUNTED SWING CABINET

- A. Chatsworth Products:
 - 1. Cat. #11900-236, 24"X36"X24," w/ plexiglass door and fan kit Cat.#12804-701.

2.7 FIBER BACKBONE CABLE

- A. Superior Essex Dry Block, Sunlight Resistant outdoor.
 - 1. Cat. #W4012x1yy.

2.8 FIBER OPTIC PANELS AND PLATES

- A. Leviton Opt-X Fiber Optic Systems.
 - 1. Rack-mounted Fiber Optic Patch Panel:
Cat. #5R1UM-F03.
w/ Fiber Optic LC Connector Mounting Plate:
Cat. #5F100-2LL.

2.9 IDENTIFICATION PRODUCTS

1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations. Hand written labeling will not be permitted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

- A. Backbone Cable for Voice Service: As specified on drawings (provide data on features, ratings, and performance for each component which is different than those listed on the drawings).
- B. Horizontal Cable for Voice Service: As specified on drawings (provide data on features, ratings, and performance for each component which is different than those listed on the drawings).

3.3 INSTALLATION

- A. Wiring Method: Install wiring in raceway except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.
- B. Install cables using techniques, practices, and methods that are consistent with Category 6e-plus rating of components and that ensure Category 6e-plus performance of completed and linked signal paths, end to end.
- C. Install cables without damaging conductors, shield, or jacket.
- D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- E. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 1. Pull cables simultaneously if more than one is being installed in same raceway.
 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.
- G. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- H. Wiring within Wiring Closets and Enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

- I. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.
- J. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.
- K. Use splice and tap connectors compatible with media types.
- L. All horizontal voice and data cables shall contain a 10 foot service loop at rack. Additional cable shall be secured near ceiling if cable enters from above or near floor if cable enters from conduits emerging from below, cable shall not be left on floor.
- M. Conduits: Conduits used to route data and voice cables that are 2" diameter or less shall have an inside bend radius that is at least six (6) times the internal diameter. Conduits larger than 2" in diameter shall have a minimum bend radius of 10 times their inside diameter. No conduit run shall have more than two (2) 90-degree bends without intervening pull-boxes. LB fittings shall not be used. Contractor shall install pull boxes every 250' minimum.
- N. All spare conduits shall have a nylon pull rope installed.
- O. Terminating Cable: Cables shall be terminated using the T568B color-coding scheme.

3.4 GROUNDING

- A. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Comply with ANSI/TIA/EIA-J-STD-607 Standards
- C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- D. Bond shields and drain conductors to ground at only one point in each circuit.
- E. Signal Ground Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

- A. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.
- B. Group connecting hardware for cables into separate logical fields.
- C. Use patch panels to terminate cables entering the space, unless otherwise indicated.
- D. No more than two levels of cross-connects are allowed in the backbone architecture. This means that from a horizontal cross-connect, only one intermediate cross-connect (in a communications Closet) can be passed through to reach the main cross-connect (in the Network Room). This limits signal degradation.

3.6 STANDARDS

- A. Comply with requirements in TIA-568-B, TIA-569, TIA-607.

3.7 IDENTIFICATION

- A. In addition to requirements in this Article, comply with applicable requirements in Division 26 Section "Basic Electrical Materials and Methods" and TIA/EIA-606.
- B. Cable and Jack Numbering: All cable terminations (jacks and patch panels) will be numbered and labeled by the Contractor according to the specifications contained here in.
 - 1. Cable shall correspond to the two-digit position on the patch panel 01-thru 48.
 - 2. These labels shall be typed on an adhesive label and affixed within 12 inches on both ends of the cable.
 - 3. RJ45 data jack numbers will correspond to the same number as on cable.
 - 4. A set of building blueprints must be provided by the Contractor with all jacks clearly marked with assigned numbers.
 - 5. Backbone cabling schematics shall be provided by the Contractor.
- C. Labeling:
 - 1. A label with a unique identifier will be used for:
 - a. Both ends of every cable.
 - b. Each termination position (port, jack).
 - c. All termination hardware (panels, blocks).
 - d. All pathways (conduit, raceways).
 - 2. All pull boxes, junction boxes and communication conduits will be labeled with "TELECOM."
 - 3. The wiring/cabling contractor will assume responsibility for labeling. Cables must be properly labeled by the contractor before MDC will assume ownership of the cable.
 - 4. Cable labels shall be machine printed, protected from moisture, located so as to be visible in the network room and in the respective terminal box.
 - 5. Workstation: Label cables within outlet boxes.
 - 6. Distribution Racks and Frames: Label each unit and field within that unit.
 - 7. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-termination and connecting hardware.
 - 8. Cables, General: Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction box or outlet box, and elsewhere as indicated.
 - 9. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.
 - 10. Cable Administration Drawings: Show building floor plans with cable administration point labeling.

3.8 TESTING OF NETWORK/TELEPHONE CABLING

- A. Pre-installation inspection.
 - 1. Visually inspect all cables, cable reels and shipping cartons to detect possible cable damage incurred during shipping and transit. Visibly damaged goods are to be returned to the Supplier and replaced at no additional cost to the Owner.
 - 2. If post-manufacture performance data has been supplied by the Manufacturer of cables or connecting hardware, copies of such data are to be kept for inclusion in the Documentation and made available to the Owner upon request.
 - 3. All materials are to be new and unused.
- B. Post-installation test and certification.
 - 1. Contractor Requirements
 - a. Contractor shall provide sufficient skilled labor to complete testing.

- b. Contractor's company shall have a minimum of 3 years experience installing and testing structured cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
- c. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
- d. Contractor is responsible for submitting acceptance documentation as defined below.

C. Test Process

- 1. Owner reserves the right to be present during any or all of the testing.
- 2. Owner reserves the right to engage a third party tester at Owners expense.
- 3. Testing shall be of the Basic Link.
- 4. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.
- 5. 100% of the installed cabling must be tested. All tests must pass acceptance criteria defined in Section F.
- 6. Test equipment shall be fully charged prior to each days testing.

D. Standards Compliance & Test Requirements

- 1. Cabling must meet the indicated performance specifications:
 - a. TIA 568-B.2-1 Category 6e-plus where required.
- 2. All test equipment used must meet the performance specifications defined in section 5 below.

E. Documentation

- 1. Test reports may be submitted in softcopy and hardcopy. Hand-written test reports are not acceptable.
- 2. Hardcopy reports are to be submitted in labeled 3-ring binders with an attached affidavit verifying passing execution of all tests. Hardcopy summary reports shall contain the following information on each row of the report: Circuit ID, test specification used, length, date of test and pass/fail result.
- 3. Test reports shall include the following information for each cabling element tested:
 - a. Wiremap results that indicate the cabling has no shorts, opens, miswires, split, reversed or crossed pairs, and end to end connectivity is achieved.
 - b. For Category 3 cabling: Attenuation and NEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point and the margin. These test results shall be performed in a swept frequency manner from 1 to 16 MHz. Information shall be provided for all pairs or pair combinations and in both directions. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - c. For Category 6e cabling: Insertion Loss, Near End Cross-talk (NEXT), Power Sum Near End Cross-talk (PSNEXT), Attenuation to Cross-talk Ratio (ACR), Power Sum ACR, ACR Far End, Power Sum ACR Far End, and Return Loss data that indicate the worst case result, the frequency at which it occurs, the limit at that point and the margin. These test results shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
 - d. Length (in meters), propagation delay and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

- e. Cable manufacturer, cable model number/type and NVP.
 - f. Tester manufacturer, model, serial number, hardware version and software version.
 - g. Circuit ID number and project name.
 - h. Auto test specification used.
 - i. Overall pass/fail indication.
 - j. Date of test.
 - k. Test reports shall be submitted within 7 business days of completion of testing both in hardcopy and electronic format.
4. Test Equipment
- a. Test equipment use under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
 - b. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output. Testing equipment shall be able to meet all requirements in ANSI/TIA/EIA-568-B.2-1
 - c. Test adapter cables must be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
 - d. Baseline accuracy of the test equipment must meet or exceed TIA level II, as indicated by independent laboratory testing.
 - e. Test equipment must be capable of certifying Category 6e-plus links.
 - f. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
 - g. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
 - h. Test equipment must be capable of running individual NEXT, return loss, etc., measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
 - i. Test equipment must store at least 1000 Category 6e-plus auto tests in internal memory.
 - j. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
 - k. Test equipment must include DSP technology for support of advanced measurements.
 - l. Test equipment must make swept frequency measurements in compliance with TIA standards.
 - m. The measurements reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

F. Acceptance

- 1. Once all work has been completed, test documentation has been submitted and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify the Contractor in writing of formal acceptance of the system.
- 2. Acceptance Requirements
 - a. Contractor must warrant in writing that 100% of the installation meets the requirements specified under Standards Compliance & Test Requirements above.
 - b. Owner reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented results. Any failing cable shall be re-tested and restored to a passing condition. In the event more than two (2) percent of the cable plant fails during re-test, the entire cable plant shall be re-tested and restored to a passing condition at no additional cost to the Owner.

- c. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation.

G. Warranty

- 1. Contractor shall warrant the Installation against all product defects and that all approved cabling components meet or exceed the requirements of TIA/EIA-568B, TIA/EIA-568A-A5 and ISO/IEC 11801 for a period of One (1) year.

END OF SECTION 260750

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
 - E. Include the following Operation and Maintenance Data:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Handle and prepare panelboards for installation according to NEMA PB 1.
- 1.6 COORDINATION
- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- 1.7 EXTRA MATERIALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.

5. Directory Card: Inside panelboard door, mounted in transparent card holder.
 6. Skirt for surface-mounted panels: Same gage and finish as panelboard front with flanges for attachment to floor and floor.
- B. Incoming Mains Location: Top or Bottom.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Rating as indicated on drawings.
- H. Provide TVSS in panel LP1 in new Workshop. Provide circuit breaker in panel for TVSS meeting manufacturer's requirements.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, furnish products from one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, furnish products from one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2.4 PANELBOARD SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, furnish products from one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Provide TVSS in panel LP1 in new Workshop.
- C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
 - a. LED indicator lights for power and protection status.
- D. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, third edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
1. Accessories:
 - a. Fuses rated at 200-kA interrupting capacity.
 - b. Fabrication using bolted compression lugs for internal wiring.
 - c. Redundant suppression circuits.
 - d. Redundant replaceable modules.
 - e. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - f. LED indicator lights for power and protection status.

- g. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- 2. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
 - a. Line to Neutral: 70,000A.
 - b. Line to Ground: 70,000 A.
 - c. Neutral to Ground: 50,000 A.
- 3. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
 - a. Retain one of four subparagraphs below. Adjust clamping voltages to comply with Project conditions and verify compatibility of peak surge current rating and clamping voltage. Reference to UL 1449 is to its second edition.
- 4. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:
 - a. Line to Neutral: 400 V.
 - b. Line to Ground: 400 V.
 - c. Neutral to Ground: 400 V.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated. Top operated device shall be mounted a maximum of 6'-7" above finished floor.
- B. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- C. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- D. Install filler plates in unused spaces.
- E. Stub four 1 1/4-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- B. Provide arc flash warning signs so as to clearly identify the hazard at the panel. Provide service entrance labeling per the latest edition of the National Electrical Code.
- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- D. Panelboard Nameplates: Label each panelboard .
- E. Device Nameplates: Label each branch circuit device in panelboards .

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Correct malfunctioning units on-site, where possible.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Snap switches.
 - 4. Communications outlets.
 - 5. Pendant cord-connector devices.
 - 6. Cord and plug sets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 RECEPTACLES

A. Convenience Receptacles, 125 V, 20A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that maybe incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell HBL5361 (single), Leviton 3561; Hubbell HBL5362 (duplex), or Leviton 3562; color Black.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell HBL; GFTR20, or Leviton WR899.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; HBL1221, or Leviton 1221-2 (single pole); HBL1222, or Leviton 1222-2 (two pole); HBL1223, or Leviton 1223-2 (three way); HBL1224, or Leviton 1224-2 (four way), color Black.

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Material for finished Spaces: stainless steel.
2. Material for unfinished spaces (shops, maintenance shops, storage areas): galvanized steel.

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum, weatherproof open.
- C. Exterior, Weatherproof-open or in-use Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum, weatherproof open.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install receptacles 48" above finished floor to top of box, unless indicated otherwise.
- B. Install snap switches 48" above finished floor to top of box.
- C. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.
- E. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- F. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Non-fusible switches
 - 2. Enclosures.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch indicated, include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 4. Operation and Maintenance Data: For enclosed switches.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of switches with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible Switch, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.3 NON-FUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Non-fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. Unless indicated otherwise on drawings.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R, Heavy Duty Type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches with tops at uniform height, unless otherwise indicated.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate. Label toggle switches and relays indicated on drawings.

3.3 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

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SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps, see drawing E-651.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Lighting luminaires.
 - 2. Structural members to which luminaires will be attached.
 - 3. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 4. Moldings.
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Recessed Fixtures: Comply with NEMA LE 4.
- C. Bulb shape complying with ANSI C79.1.
- D. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- E. Internal driver.

2.2 MANUFACTURERS

- A. See drawing E – 601 for lighting schedule.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 COMMUNICATION CABLE

- A. Communication Cable: Comply with TIA/EIA – 568-B, enhanced category 5e, four thermoplastic – insulated, individually twisted pairs of conductors, 24 AWG, color coded white, enclosed in PVC jacket, capable of supporting signals of no less than 250 MHz

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.4 ADJUSTING

A. Occupancy Adjustments: Within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees and vegetation to remain.
 - 2. Removing trees and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Topsoil stripping.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
 - 2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
 - 3. Division 32 Section "Turf and Grasses" for finish grading, including placing and preparing topsoil for lawns and planting.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. Coordination drawings according to Division 01 Section "Project Management and Coordination."
 - 1. Clearly identify and accurately locate proposed material stockpile locations and associated soil erosion control measures in coordination drawings for site clearing.
 - 2. Identify site clearing activities that will be executed in separate sequences in accordance with the Contractor's schedule of proposed work.
- B. Record drawings according to Division 01 Section "Closeout Procedures."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions, if applicable, and any other conditions that differ from the project drawings.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 UTILITIES

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Project Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Project Engineer's written permission.

3.3 CLEARING AND GRUBBING

- A. Clearing of trees greater than 3-inches in diameter shall occur between the dates of November 1 and March 31. Clearing of trees greater than 3-inches in diameter outside of the specified time is prohibited.
- B. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed finished subgrade.
 4. Use only hand methods for grubbing within drip line of remaining trees.
- C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Limit height of topsoil stockpiles to 72 inches .
 2. Do not stockpile topsoil within drip line of remaining trees.
 3. Stockpile surplus topsoil and allow for resspreading deeper topsoil.

3.5 DISPOSAL

- A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, unburned cleared material and legally dispose of them off Owner's property.
- B. Cleared material shall be piled or chipped and removed off of the Owners property. Rubbish or waste materials shall be removed from the area and legally disposed of off of the Owners property.
- C. Merchantable timber within the clearing limits will become the property of the Contractor unless otherwise specified.

END OF SECTION 311000

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SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrades.
 - 2. Excavating and backfilling.
 - 3. Aggregate Base courses.
 - 4. Excavating and backfilling trenches within building lines.
 - 5. Excavating and backfilling trenches for buried mechanical and electrical utilities, pits and utility structures.
 - 6. Aggregate surface course.
 - 7. Drainage and separation fabric.
- B. Related Sections include the following:
 - 1. Division 00 Section "Soils Information" for Geotechnical Report, and Soil Testing.
 - 2. Division 01 Section "Summary" for Summary of the Work, phases, products ordered in advance, Owner-furnished products, use of the premises and work restrictions.
 - 3. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
 - 4. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder, under footings, beside foundations, and beneath the slab-on-grade.
 - 5. Divisions 22 and 26 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
 - 6. Division 31 Sections "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
 - 7. Division 32 Section "Turfs and Grasses" for finish grading, including placing and preparing topsoil for lawns and plantings.

1.3 DEFINITIONS

- A. Backfill: Soil materials or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Aggregate Surface Course: Aggregate layer placed on top of aggregate base course to provide a finish grade aggregate surface.
- C. Aggregate Base Course: Layer placed between the subgrade and footings, foundations, building floors and slabs, walkways, pavements, aggregate surfacing and structures and other site improvements.

- D. Aggregate Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- E. Borrow: Satisfactory soil imported from a designated borrow area or from off-site for use as fill or backfill.
- F. Drainage Course: An aggregate base layer supporting slab-on-grade used to minimize capillary flow of pore water.
- G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 48,510-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- H. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Project Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Project Engineer. Unauthorized excavation, as well as remedial work directed by Project Engineer, shall be without additional compensation.
- I. Embankment Fill: All compacted fills above the areas that have been stripped and filled to the original ground line to the lines and grades shown in the contract drawings and specified herein.
 - 1. Fill: Soil material, or rock excavated on-site, or borrow used to raise existing grades.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, pavements, sidewalks, curbs, mechanical and electrical appurtenances, utility structures or other man-made stationary features constructed above or below the ground surface.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, sub-base, drainage fill, or topsoil materials.
- L. Surface Course: The surface layer placed over a base or subgrade as indicated on plans.
- M. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- N. Surplus Excavation (spoil): Excess soil material obtained from authorized excavation.

- O. Waste Material: Waste material includes soil contaminated by construction activities, existing trash and debris located within the construction limits, trash and debris generated by construction activities, unused construction materials not incorporated into the work, and other unwanted materials within the construction limits as designated by the Project Engineer.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of warning tape.
 - 2. Geotextile drainage fabric.
 - 3. Soil separation fabric.
 - 4. Controlled low-strength material, including design mixture.
- B. Samples: For the following:
 - 1. 12-by-12-inch sample of geotextile drainage fabric.
 - 2. 12-by-12-inch sample of soil separation fabric.
 - 3. Warning Tape: 12 inches long; of each color.
- C. Certification of conformance; gradation test results; and relative density as determined in accordance with ASTM D4253 and D4254 for all aggregate materials.
- D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

- A. Blasting: Blasting is not included within this contract.
- B. Preexcavation Conference: Conduct conference at the Project site.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Project Engineer and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Do not proceed with utility interruptions without Project Engineer's written permission.
 - 2. Contact utility-locator service for area where Project is located before excavating. Notify "Missouri One Call System", 1-800-344-7483 (1-800-DIG-RITE) before beginning earthmoving operations.
- B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls" and Division 31 Section "Site Clearing" are in place.

- D. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Facilities and Controls" are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Additional borrow material is available onsite with Project Engineer's approval.
- B. Satisfactory Soils: On-site soils identified as Soil Classification Groups CL, ML, CH, GC, SC, GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 6- inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups OL, MH, OH, and PT according to ASTM D 2487, or a combination of these groups, and imported soils identified as Soil Classification Group CH according to ASTM D 2487.
- D. Impervious Fill: Clay, Clayey gravel and sand mixture capable of compacting to a dense state.
- E. Engineered Fill: Satisfactory soils or aggregate materials.

2.2 AGGREGATE MATERIALS

- A. Base Course Materials:
 - 1. For locations below and beside footings: MoDOT Section 1007, Type 1 aggregate (2011).
- B. Porous Backfill: MoDOT Section 1009, Grade 3, 4 or 5 aggregate (2011) or 1-inch clean where indicated on the drawings.
- C. Utility Pipe Bedding Material: Aggregate waste lime (5/8 inch minus).
- D. All aggregate materials shall meet the requirements of MoDOT Section 1000, material Details (2011).

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

2.4 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile specifically manufactured for use as a separation geotextile; made from polyolefins, or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Tensile Strength (at 2% strain): 400 lbf; ASTM D 4595.
 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 4. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
 5. Apparent Opening Size: No. 30; ASTM D 4751.
- B. Subsurface Drainage Geotextile: Non-woven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; with elongation greater than 50 percent; and with the following minimum properties determined according to AASHTO M 288 and the following measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Tensile Strength: 120 lbf; ASTM D 4632.
 3. Trapezoid Tear Strength: 50 lbf; ASTM D 4533.
 4. CBR Puncture Strength: 300 lbf; ASTM D 6241.
 5. Permittivity: 1.0 per second, minimum; ASTM D 4491.
 6. Apparent Opening Size: No. 70; ASTM D 4751.
 7. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours and datum.
- B. Identify and flag all utilities.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- D. Protect and maintain erosion and sedimentation controls during earth moving operations in accordance with the approved SWPPP.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering techniques as required to prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- C. The Contractor is responsible for all necessary dewatering that site conditions may require and the cost of which should be included in the contractor's bid for this project.

3.3 EXPLOSIVES (NOT USED)

3.4 EXCAVATION, GENERAL

- A. All excavation is unclassified. There will be no extra payment for rock excavation.
 - 1. Excavation includes, excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, rock and other materials.
 - 2. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Maintain excavations within the moisture range as required to achieve specified compaction. The Contractor shall maintain the moisture content by applying moisture to the excavations in the form of a fine mist or using other approved measures.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing aggregate base and for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations:
 - a. Do not disturb bottom of excavation.
 - b. Excavate by hand to final grade just before placing and compacting aggregate base or placing concrete reinforcement.
 - c. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - d. Subgrade shall be hand cleaned of all loose materials, or loose materials should be machine tamped into the subgrade with a tamping compactor.
 - e. "Back dragging" a backhoe bucket to compact loose materials and to smooth teeth marks in the subgrade will not be allowed.
 - f. Any loose materials, soil clods or crumbs should be removed before placement of compacted aggregate base and concrete.

- g. To minimize drying of subgrades due to exposure, excavation for concrete foundations shall be excavated and have the compacted aggregate base placed within 18 hours unless subgrades are covered with plastic to prevent drying. Maintain excavations within the moisture range as required to achieve specified compaction. The Contractor shall maintain the moisture content by applying moisture to the excavations in the form of a fine mist or using other approved measures. Contractor is responsible for supply and delivery of water to maintain soil moisture content.
 - h. To minimize excess hydration of subgrades due to exposure, excavation for concrete foundations shall be excavated and have the compacted aggregate base placed without exposing excavated subgrades to rainfall.
 - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.
 - B. Excavations at Edges of Tree-and Plant Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears or pulls roots.
 - 2. Cut and protect roots according to requirements in Division 01 Section "Temporary Facilities and Controls".
- 3.6 EXCAVATION FOR WALKS, PAVEMENTS AND ROADS
- A. Excavate surfaces under walks, pavements and road to indicated cross sections, elevations, and subgrades.
- 3.7 EXCAVATION FOR UTILITY TRENCHES
- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
 - C. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Division 01 Section "Temporary Facilities and Controls."

3.8 APPROVAL OF SUBGRADE

- A. Notify Contract Supervisor when excavations have reached required subgrade.
- B. If the Contract Supervisor determines that unsatisfactory soil is present or that the subgrade is unsuitable, continue excavation and replace with compacted backfill or fill material.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. The Contractor shall be responsible for protecting subgrades from damage by freezing temperatures, frost, rain, accumulated water, construction activities, etc. Reconstruct/repair damaged subgrades as directed by Project Engineer. No additional compensation will be provided to the Contractor for reconstructing/repairing damaged subgrades.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by the Project Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials, topsoil, and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover or wet as needed to prevent windblown dust.
- B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Inspecting and testing underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Trenches Under Footings: Backfill trenches excavated under footings and within 24- inches of bottom of footings with MoDOT type 1 aggregate base to elevation of bottom of footings.

- C. Trenches Under Roadways: Backfill utility trench to subgrade completely with limestone screenings (5/8 inch minus) compacted to 95% density in 4-inch maximum lifts. Use a hand held mechanical tamper.
- D. Place and compact initial backfill of approved backfill material, free of particles larger than 1 inch, to a height of 6- inches over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Backfill voids with satisfactory materials while shoring and bracing, and as sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade elevations. Backfill in layers not to exceed 4 inches. Care shall be taken to insure the pipe is not disturbed during the backfill operation. Backfill shall be compacted to 90% of Standard Proctor to final subgrade unless in an area with more stringent compaction requirements. Use a hand held mechanical tamper to subgrade elevations. Utility Trench final backfill (above the initial backfill) shall be satisfactory soil material free of rocks greater than 6-inches in diameter, frozen material and organic matter including but not limited to root wads, limbs, brush, and construction debris.
- H. Where trench is routed below structures or pavements, the contractor shall back fill the entire trench depth with approved aggregate material. Use a hand held mechanical tamper for compaction of aggregate materials to subgrade elevations.
- I. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Disc, or break up (scarify) soil foundation surfaces to a depth not less than 6" so fill material will bond with existing surface.
 - 2. The Contractor shall proof-roll all soil foundations before placement of fill materials.
 - 3. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. When soil foundation to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.
- C. Place fill material in layers to required elevations using satisfactory soil materials.
- D. Surfaces that become too smooth or hard for adequate bonding of the next lift shall be scarified before placing the next lift.
- E. Fill within 5 feet of structures shall be compacted with a hand held mechanical tamper.
- F. Place fill on subgrades free of mud, frost, snow, or ice.

3.14 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated mechanical tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil and well grade aggregate base to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, proposed structures, proposed building slabs, roads, proposed parking areas, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
 - 3. Under lawn or unpaved areas in non-structural fills, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent.
- D. Compact clean aggregate base, aggregate surfacing and porous backfill to not less than 95 percent relative density as determined in accordance with ASTM D4253 and D4254. Maintain within -3 percent and +3 percent of optimum moisture content.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 - inch.
 - 2. Walks: Plus or minus ½ -inch.
 - 3. Pavements: Plus or minus ½-inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of ½-inch when tested with a 10-foot straightedge.

3.16 SOIL SEPARATION FABRIC:

- A. Install according to AASHTO M 288-96, the manufacturer's installation guidelines and the following.
- B. Preparation and Inspection:
 - 1. Clean off all foreign substances which include, but not limited to, debris, roots, organic matter, refuse, ashes, cinder, and rock with any dimension greater than 3 inches.
 - 2. Correct any ruts or soft yielding spots or any areas with inadequate compaction, by removing material and replacing with properly compacted fill or course granular base.

3. Prepare soil foundation in the areas receiving the fabric, as required for the placement of compacted fill and as recommended by the fabric manufacturer.
 4. Proof roll subgrade with compaction equipment and with Contract Supervisor watching before placement of fabric. Repair any areas in subgrade not complying with installation or compaction requirements.
 5. Contract Supervisor will inspect for adequate compaction and surface tolerances prior to placing aggregate base. The condition soil foundation in the areas receiving fabric, must be approved by the Contract Supervisor prior to the placement of the fabric.
 6. Notify Contract Supervisor prior to the placement of any fabric.
 7. Verify soil foundation is compacted and is ready for installation of the fabric as required by fabric manufacturer.
 8. Beginning of installation means acceptance of existing conditions.
 9. Verify all submittals for this section have been approved before starting work.
- C. Installation: As per fabric manufacturer's recommendations and the following.
1. Location:
 - a. The fabric shall be placed on the top of the soil foundation before the placement of any base material.
 - b. Where the fabric is installed below pavement or curbs, the fabric shall be installed so as to extend to the outer most edges of the pavements or curbs.
 2. Overlaps when necessary shall be a minimum of 24" side lap and 36" end laps. Layout fabric in direction of traffic.
 3. No fabric shall be left uncovered longer than 24 hours.
 4. The Contractor shall exercise care in the placement and maintenance of the fabric.
 5. Any fabric which is contaminated or damaged shall be rejected.

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 12 inches of filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches.
- B. Subsurface Drainage Fabric: Install subsurface drainage fabric according to AASHTO M 288-96 and manufacturer's installation guidelines.

3.18 AGGREGATE BASE AND SURFACE COURSES

- A. Place base and surface course material on prepared subgrades. Place base course material on subgrades free of mud, frost, snow, or ice.
 1. Shape subgrade and base to required crown elevations and cross-slope grades.
 2. When thickness of compacted base or surface course is 6 inches or less, place materials in a single layer.
 3. When thickness of compacted base, surface or shoulder course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
 4. Compact aggregate base course in accordance with Section 203.5.5 of the Missouri Standard Specifications for Highway Construction.

5. Compact aggregate surface course to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- B. Delivery:
1. Excessive moisture in aggregate delivered to site will not be permitted. The Contract Supervisor will visually inspect each load prior to dumping. Loads with moisture content above that allowed for compaction will be rejected.
- C. Stockpiles:
1. Stockpile only with approval of the Contract Supervisor.
 2. Clear and level storage sites prior to stockpiling.
 3. Place in a manner and at locations approved by the Contract Supervisor providing separate stockpiles for materials from separate sources.
 4. Prevent aggregate from segregating during placement, storage, and handling at stockpiles.
- D. Cold-Weather Limitations:
1. Base and surface course construction shall be prohibited when atmospheric temperature is below 35 degrees Fahrenheit unless permitted otherwise by the Project Engineer.
 2. Do not place base or surface courses on wet or frozen subgrade.
 3. Protect Base and surface courses and subgrade in freezing weather and repair areas damaged by freezing by reshaping and recompacting prior to placing pavements.
- E. Preparation of Subgrade:
1. Clean off all foreign substances which include, but not limited to, debris, roots, organic matter, refuse, ashes, cinder, and rock with any dimension greater than 3 inches.
 2. Correct any ruts or soft yielding spots or any areas with inadequate compaction, by removing material and replacing with properly compacted fill or course granular base.
 3. Contract Supervisor will inspect for adequate compaction and surface tolerances prior to placing aggregate base.
- F. Maintenance:
1. Maintain finished base or surface courses in a condition as required by the Contract Documents.
 2. Repair or replace base or surface courses not satisfying the Contract requirements.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Protect newly graded subgrade from freezing prior to placement of aggregate base, drainage course, or cast-in-place concrete.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Project Engineer; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 FIELD QUALITY CONTROL

- A. Inspections and Testing: Allow the Contract Supervisor or a qualified testing agency to inspect and test each subgrade, fill, backfill, base and surface. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
 - 1. Field in-place density tests shall be performed using the nuclear method according to ASTM D2922.
 - 2. When the tests show that the subgrades, fills, backfills, base, surface or shoulder courses are below the specified density, scarify and moisten or aerate, or remove and replace soil or base to the depth required, re-compact and re-test until the required density is obtained.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Surplus excavation or unsuitable soil excavation shall be placed, compacted and shaped onsite within the designated spoil areas as directed by the Project Engineer.
- B. Surplus top soil material as specified herein shall be stockpiled on the Owners property as shown on the drawings or as directed by the Project Engineer.
- C. Waste materials shall be legally disposed of off the project site.

END OF SECTION 312000

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Seeding of all disturbed areas.
 - 2. Protection of existing trees.

- B. Related Sections:

- 1. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.3 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
- C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5percent weed seed:
 - 1. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 10 percent perennial ryegrass (*Lolium perenne*).
 - b. 90 percent turf type fescue.

2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- 2.3 PLANTING SOILS
- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
- 2.4 MULCHES
- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Hardwood Mulch: Provide air-dry, clean, and mildew-free for tree protection.
- 2.5 EROSION-CONTROL MATERIALS
- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydro-seeding and hydro-mulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
 - 3. Protect existing trees as shown with 12" deep layer of hardwood mulch around trees. Mulch shall extend to drip line of tree then taper to existing grade.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m).
- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

3.4 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 330500 – COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Sleeves.
 - 5. Identification devices.
 - 6. Grout.
 - 7. Piped utility demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Metal supports and anchorages.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Dielectric fittings.
 - 2. Identification devices.
- B. Samples of color, lettering style, and other graphic representation required for each identification material and device.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Natural and LP Gas: PE Pipe, ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.
- B. Domestic Water: PE, ASTM Pipe, ASTM D 2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than 160 psig.
 - 1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
 - 2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.3 JOINING MATERIALS

- A. Refer to individual piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.

- c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- 1. Available Manufacturers:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Co.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- 1. Available Manufacturers:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Co.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:

- a. Perfection Corp.
- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.
- d. Victaulic Co. of America.
- e. Equal.

2.6 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Basic Mechanical Materials and Methods for Plumbing."
- B. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 01 Sections "Execution" and Division 02 Section "Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 2 and 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 2 and 22 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Stenciled Markers: According to ASME A13.1.
 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 3. Locate pipe markers on exposed piping according to the following:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 - d. At manholes and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 4000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500