PARAGON
ARCHITECTURE

PROJECT MANUAL

MARSHFIELD R-I SCHOOL DISTRICT

MARSHFIELD EARLY CHILDHOOD CENTER

600 N Locust Street
Marshfield, Missouri 65706

Project # 20-602

Issue Date | June 9, 2021

PROJECT MANUAL

PROJECT:

MARSHFIELD EARLY CHILDHOOD CENTER
600 N Locust St.
Marshfield, Missouri 65706

OWNER:

MARSHFIELD R-I SCHOOL DISTRICT
600 N Locust St.
Marshfield, Missouri 65706

ARCHITECT OF RECORD: PARAGON ARCHITECTURE

637 W College St
Springfield, MO 65806
Phone: 417.885.0002

Project Contact: Kirsten M. Whitehead

STRUCTURAL ENGINEER OF RECORD: J&M Engineering

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Springfield, Missouri 65807
Phone: 417.708.9315

Project Contact: Charles Taylor

MECHANICAL/ELECTRICAL ENGINEER OF RECORD: RTM Engineering Consultants

3333 E Battlefield Rd Suite 1000
Springfield, Missouri 65804
Phone: 417.881.0020

Project Contact: Jennifer Luce

CIVIL ENGINEER OF RECORD: Toth & Associates

1550 E Republic Rd
Springfield, Missouri 65804
Phone: 417.888.0645

Project Contact: Matt Miller

CONSTRUCTION MANAGER: RE Smith Construction Company

1036 West 2nd Street
Joplin, Missouri 64801
Phone: 417.623.4545

Project Contact: Mike Freitas

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ARCHITECTURAL SPECIFICATION DISCLAIMER

PROJECT: **Marshfield Early Childhood Center**
OWNER: **Marshfield R-I School District**
LOCATION: **600 N. Locust St., Marshfield, MO 65706**

ARCHITECT: PARAGON ARCHITECTURE, LLC
637 W. COLLEGE STREET, SPRINGFIELD, MO 65806
1310 S MAIN STREET, JOPLIN, MO 64801
P: 417.885.0002

The Specifications to be authenticated by Paragon Architecture and the undersigned seal is limited to the specification sections listed below. Paragon Architecture hereby disclaims any responsibility for all other specification sections relating to or intended to be used for any part of this project other than those prepared by Paragon Architecture, LLC.

040511	MORTAR AND MASONRY GROUT
042001	MASONRY VENEER
042616	ADHERED MASONRY VENEER
061010	NON-STRUCTURAL ROUGH CARPENTRY
062000	FINISH CARPENTRY
071400	FLUID-APPLIED WATERPROOFING
071900	WATER REPELLANTS
072100	THERMAL INSULATION
072119	FOAMED-IN-PLACE INSULATION
072126	BLOWN INSULATION
072500	WEATHER BARRIERS
075400	THERMOPLASTIC MEMBRANE ROOFING
076200	SHEET METAL FLASHING AND TRIM
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102800	TOILET, BATH, AND LAUNDRY ACCESSORIES
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06/08/2021
JIM W. STEARMAN, ARCHITECT
MO #: A-2020039367

SPECIFICATION DISCLAIMER

PROJECT: Marshfield Early Childhood Center

OWNER: Marshfield R-1 School District

LOCATION: Marshfield, MO

CIVIL ENGINEER: TOTH AND ASSOCIATES, INC
1550 EAST REPUBLIC ROAD
SPRINGFIELD, MO 65804
P: (417) 888-0645
MISSOURI COA #2004004242

The Specifications to be authenticated Toth and Associates and the undersigned seal is limited to the specification sections listed below. Toth and Associates herby disclaims any responsibility for all other specification sections relating to or intended to be used for any part of this project other than those prepared by Toth and Associates, Inc.

024113	SITE DEMOLITION
311000	SITE CLEARING
312300	EXCAVATION AND FILL
312500	EROSION AND SEDIMENTATION CONTROLS
321100	CAST-IN-PLACE CONCRETE FOR SITEWORK
321216	ASPHALT PAVING
321373	CONCRETE PAVING JOINT SEALANTS
321723	PAVEMENT MARKINGS
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333100	SEWER UTILITY SEWERAGE PIPING
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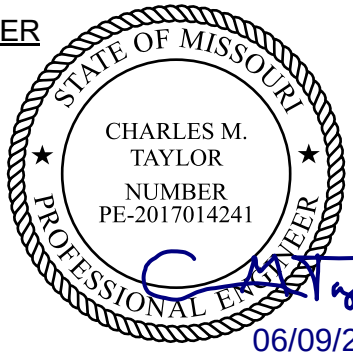
334100	STORM UTILITY DRAINAGE PIPING
334900	STORM DRAINAGE STRUCTURES

STRUCTURAL SPECIFICATION DISCLAIMER

PROJECT: Marshfield ECC
OWNER: Marshfield School District
LOCATION: 600 N. Locust St
Marshfield, MO 65706

ENGINEER: J&M ENGINEERING, LLC
3045 S. KANSAS EXPY
SPRINGFIELD, MO 65807
P: 417-708-9315

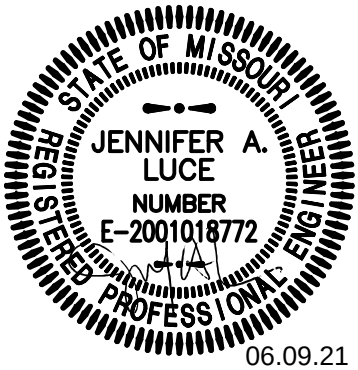


06/09/2021

The Specifications to be authenticated by J&M ENGINEERING, LLC and the undersigned seal is limited to the specification sections listed below. J&M hereby disclaims any responsibility for all other specification sections relating to or intended to be used for any part of this project other than those prepared by J&M ENGINEERING, LLC.

SPECIFICATION DISCLAIMER

PROJECT:	Marshfield Early Childhood Center #20-602
OWNER:	Marshfield School District
LOCATION:	600 N. Locust St, Marshfield, MO 65706
ARCHITECT:	RTM ENGINEERING CONSULTANTS 3333 E. Battlefield Rd, Suite 1000 Springfield, MO 65804 P: 417.881.0020



06.09.21

The Specifications to be authenticated by RTM Engineering Consultants and the undersigned seal is limited to the specification sections listed below. RTM Engineering Consultants herby disclaims any responsibility for all other specification sections relating to or intended to be used for any part of this project other than those prepared by RTM Engineering Consultants.

SECTION 21 – FIRE SPRINKLER SYSTEM

DIVISION 22 – PLUMBING

DIVISION 27 – COMMUNICATIONS

00 01 13 ADVERTISEMENT FOR BIDS

Notice is hereby given that sealed bids for **Marshfield Early Childhood Center** will be received at the **Marshfield High School, in the Library, at 370 State Hwy DD, Marshfield, MO 65706** until **3:00 pm** on **06/29/21** and then publicly opened and read aloud.

The **Marshfield Early Childhood Center** project consists of **approximately 24,000 SF early childhood center that includes 12 classrooms (8 preschool and 4 special education), a library, administration offices, warming kitchen and an ICC-500 rated shelter.**

Bidders may obtain Contract Documents on **06/10/21** from: **Engineers Reprographics, 1600 E. St. Louis St., Springfield, Missouri 65802, Phone: 417-869-2222.** Sets are available for a refundable deposit and are available digitally at **www.erplanroom.com** and **www.resmithconst.com.** For more information, please contact Kirsten M. Whitehead at Paragon Architecture, whitehead@paragonarchitecture.com.

The Owner reserves the right to award the contract to the lowest responsible bidder and to reject any and all bids and to waive any informality on all bids. No bid may be withdrawn for a period of thirty **(30) days.**

All bidders must provide a sworn affidavit affirming participation in a federal work authorization program and stating that the bidders does not knowingly employ any person who is not authorized to work in the U.S. **The contractor must comply with current Prevailing Wage laws and other statutory regulations as referred to in the specifications. This project is tax exempt.**

A Pre-Bid Conference will be held at **2:00 pm** on **06/16/21** at **Hubble Elementary School, near the playground, at 600 North Locust, Marshfield, MO 65706**.

Substantial Completion: All work for this project shall be substantially complete by **08/12/22**.

SECTION 002000 – BID PACKAGES

SECTION 00 20 00 - SCOPES OF WORK (BID PACKAGES)

SCOPES OF WORK (BID PACKAGES)

Common Requirements	Provisions (Applicable to **ALL** Bid Packages)
Bid Package 03	Concrete
Bid Package 04	Masonry
Bid Package 05	Structural Steel
Bid Package 06	Millwork
Bid Package 07	TPO Roofing
Bid Package 07A	Waterproofing/Air Barrier
Bid Package 08	Glass/Glazing
Bid Package 08A	General Trades
Bid Package 09	Metal Studs/Gyp Board/Ceilings
Bid Package 09A	Flooring
Bid Package 09B	Painting/Graphics
Bid Package 13	PEMB Erection/Misc
Bid Package 21	Fire Suppression
Bid Package 22	Plumbing
Bid Package 23	HVAC
Bid Package 26	Electrical
Bid Package 31	Site Work/Site Demolition/Storm Drain Piping
Bid Package 32	Asphalt Paving

Common Requirements

Provisions (Applicable to *ALL* Bid Packages)

A. The Common Requirements Section is to be included by ALL Bid packages and include, but are not limited to the following:

1. You are bidding on a project that is under a Construction Management at Risk (as Constructor) contract. The Construction Manager at Risk (as Constructor) is RE Smith Construction Co. If your company enters into an agreement with RE Smith Construction all requirements of this section will be included in your agreement. RE Smith Construction **will not** enter into any agreement with Subcontractors or Suppliers who have in the past displayed unethical behavior or business practices or who supports unethical or illegal behaviors or business practices. An example of unethical behavior is if a company provided a deduct cost on an alternate on the bid day bid form and then in the future is asked for the deduct and the company provides less than the bid day deduct amount.
2. Your bid shall include all items per plans and specifications for a complete system unless noted otherwise. If you would like to provide a product that is not listed in the plans or specifications as an equal, you must do so during the bidding period and get approval to use said product from the Construction Manager (furthermore known as CM) and the Architect/Engineer, via addendum.
3. The Notice to Proceed is anticipated to be issued the week of June 12th, 2021. If the Notice to proceed is delayed the project schedule will be amended accordingly with no detriment to Owner.
4. Substantial Completion is scheduled for 08/12/2022.
5. The CM's Project Manager, as assigned, shall be the Final Decision Maker on all matters concerning the CM's documents.
6. Testing and Inspections is by the Owner.
    a. All Subcontractors are to notify the CM at least 24 hours in advance for ALL tests per plans and specs that require third party testing.
    b. If it is necessary, by no fault of the Owner or CM, to re-test/re-inspect due to a Subcontractors' inability to perform as required or initial test is non-conforming, the cost of the re-test/re-inspection will bear solely on the Subcontractor.
7. Excessive use of any on-site utilities will not be tolerated, and the CM reserves the right to charge Subcontractors or terminate the use of the utility (ies) for said Subcontractors. Excessive use includes but is not limited to faulty water hoses, electrical devices that remain on while not in use, etc.
    a. The Electrical Bid Package, Bid Package 26 will Provide and maintain interior temporary lighting as required by provisions of OSHA CFR 1926 Subpart D standard number 1926.53 (Table D-3). Subcontractors working outside the interior building envelope will be required to provide their own temporary lighting as required for their bid package to be completed with-in the project schedule.
8. All Bid Packages are to include all work necessary for mock-ups as listed in the project specifications. Include all costs necessary for procuring material for this work, including additional delivery and shipping fees. Mock ups will need to be completed prior to the actual materials being permanently placed on the building.
9. The CM will provide temporary toilets and dumpsters as required for construction.
10. It is every Subcontractors' responsibility to clean-up all work areas of their own debris/materials as was created by their work. Final Clean-Up is by the CM as part of the General Requirements.
    a. Trash/debris is to be collected by the Subcontractor and deposited into jobsite dumpsters as required **DAILY** or as directed by the CM. This includes sweeping each work area. Excess or materials that have not been installed will be neatly arranged

in **NON COMMON AREAS**. The project superintendent will be the final authority on where materials can be stored while onsite.

b. All conveyance, moving and transporting of Construction debris will be the responsibility of the Subcontractor who created the trash/debris.

11. All Layout and staking as required to complete this bid package in its entirety. CM will provide control points and benchmarks only.
12. Shoring, blocking, bracing etc. necessary to complete any work with-in their respective Bid package is the sole responsibility of that subcontractor.
13. All excavations are to be per Safety Requirements, OSHA and RE Smith Construction Safety Policies.
14. Coordinate with the CM and other trades as necessary to ensure the overall project schedule is met.
    a. Includes but not limited to
        i. Progress Meetings
        ii. Work in place
        iii. Pre-Installation Meetings
        iv. Submittals
        v. RFI's
        vi. ASI's and SI's
        vii. PR's and CO's.
15. Coordination and requirements in purchasing and maintaining of any and all permits, inspections, verification, utility locates, tap fees as needed and requirements of and by any and all State, Federal and Local Authorities Having Jurisdiction.
16. This Job Site is NON-SMOKING/NON-VAPING and any person(s) violating this requirement shall be subject to a $100 fine/occurrence. There will be no warnings for this offense. First time violation is a $100.00 fine. Second offense is removal from the jobsite and back charges issued if this creates a delay in the construction schedule, and a $100.00 fine.
17. This job will utilize Submittal Exchange for all Construction Document Collaboration; Submittals, RFI's, PR's, ASI's/SI's, Meeting Minutes, Schedules, Closeout Documents, other items deemed necessary by CM.
    a. All information will be available to all subcontractors on Submittal Exchange and it is the Subcontractors' responsibility to respond with-in 48 hours to the CM of any costs associated to newly uploaded ASI's, SI's, PR's etc. After 48 hours a no cost change will be entered for the Subcontractor if no response is received by the CM and any costs associated with the work of the Bid Package will bear solely on the Subcontractor.
18. Plans and Specifications are available for viewing/download at the locations described in the Project Manual.
    a. Plans and Specifications will be available for view and download on Submittal Exchange after bidding for awarded subcontractors.
    b. Any and all costs that arise from the Subcontractor procuring Plans and/or Specifications fall directly on the Subcontractor.
19. Submittals are considered here-in to be time sensitive where-in all submittals need to be collected by the Subcontractor per specific sections included in their relative scopes of work and uploaded to Submittal Exchange, Submittal Tab in the correlating section no later than by the dates set in the Submittal Schedule.
20. Include all Safety Requirements including but not limited to, OSHA, R.E. Smith Construction Company other Authorities having Jurisdiction and are to be adhered to at all times. Fall Protection is the duty of each individual Subcontractor until such time as temporary or permanent guardrails are in place.

a. Safety is of the utmost concern to R.E. Smith Construction and unsafe acts will not be tolerated.
    i. Unsafe conditions shall be reported to the Site Superintendent immediately
    ii. Unsafe Practices shall be reported to the Site Superintendent immediately
    iii. Hard Hats and Safety Glasses (ANSI Z87.1) are required at all times. No shorts, tennis shoes, cut-off t-shirts or other inappropriate attire will be permitted.
    iv. High-Reflectivity jacket, vest or shirt must be worn at all times on site.
    v. Failure to provide and use the required PPE will result in the worker being removed from the site and back charges will be issued if this creates a delay in the construction schedule.

21. All Subcontractors, Subcontractors employees, Subcontractors Third-Tier Subcontractors, Visitors etc. before coming on site must have on adequate PPE (Hard Hat and Safety Glasses, High-Reflectivity vest/shirt minimum) and will be required to Sign-In and Sign-out at the Superintendent's Job Site Trailer.
22. This job requires all employees of all Subcontractor Companies performing work to have at minimum a 10 hour OSHA construction hazard training class. The class is to be approved by OSHA and the employee must maintain on their person or in close proximity proof of such training.
    a. Employees will be required to show at start of work, proof of the training and this information will be recorded on site. The Subcontractor must also provide this information to R.E. Smith Construction's Project Manager prior to employees doing work.
23. Include all requirements of the Subcontract between R.E. Smith Construction Company and the Subcontractor as included in Attachment. No changes to the contract will be allowed. After execution of the contract or after the Notice to Proceed has been sent to the Subcontractor, the CM may at any time direct the Subcontractor to do extra work and the CM has sole discretion as to whether extra work is done on an invoice or as a Change Order. Email approvals from the CM's Project Manager to the Subcontractor shall be approved and work shall proceed the same as if there was a signed copy of the Change.
24. Any Safety related item installed by other Bid Packages that needs to be removed, moved, altered etc. to allow work of this Bid Package, is to be removed by this Bid Package and re-installed in the appropriate manner after this Bid Package work is complete in subject area.
25. No exclusions to a bid package will be allowed. If any exclusion is listed on a bid form, the bid will be identified as non-responsive.
26. Hoisting, Conveying, Moving of all material, tools, equipment etc. is the duty of each Subcontractor for their own scope of work.
27. Where/When/If the word Contractor, General Contractor or similar is written in the plans and/or specifications this will mean to be by the Sub-Contractor of that Scope of Work/Bid Package. All work of this project is included in the Bid Packages except those items expressly written as by the CM or Owner and will fall to the relevant Bid Packages/Scopes of Work as can be reasonably inferred by similar work of the project.
28. Subcontractors and Suppliers are responsible for providing the most stringent in any case of any discrepancies found in the project documents so that the CM, if any instances are brought into question, can decide between the two instances.
29. Subcontractors may be required to include the cost of their performance and payment bond. Include this amount in the location indicated on the bid form in the amount of 100% of the contract sum. If proposal is accepted and Bonds are required they shall be on the standard form of the AIA Document A312 with such Sureties as may be approved by the CM.
30. Bids shall be made on the Bid Form included in the project manual.
    a. Bids shall be submitted as discussed in the project manual.

b. ALL Bids will require a Bid Bond. See the specifications.

31. A Preliminary Construction Schedule from the CM will be provided as soon as possible. It is imperative that each Subcontractor reviews the schedule as failure to meet the schedule will result in the Subcontractor being held responsible for Liquidated and/or Real Damages as indicated in the project manual. This schedule will be revised at each progress meeting throughout the project and Subcontractors are to adhere to the dates as scheduled.
    a. Subcontractors shall provide their own schedule at maximum 7 days after a NTP is sent to them by the CM. They will have input on items of the project schedule as made by the CM, as the Schedule of Values will mirror the Project schedule, as well as progress meetings but the completion date is set and the CM will ultimately schedule as appropriate to meet this deadline.
32. On projects mandated by Prevailing Wage or the Davis Bacon Act: Certified/Signed payroll reports will be required of ALL WORKERS who perform work on this project and will be submitted in duplicate no later than with the current month's payment applications.
    a. If no work occurs for a certain week but the Subcontractor has worked previous weeks, A "NO-WORK" week payroll report will be sent. This can be used up to one month for no work.
33. Payment Applications will be required and must be on AIA G702 with schedule of Values AIA G703 or similar. The Schedule of Values will be broken out sufficiently and approved by the CM prior to any payments.
    a. All Material and/or Lower-Tier Subcontractor Invoices for the current pay period must accompany each Pay Application.
    b. Partial or Full Lien Releases/Waivers must accompany the Pay Application starting with Pay App #2 and must be on the Approved Subcontractor Supplier List. Lien Releases must be provided by all suppliers or lower-tier subs as well as for the Subcontractor itself.
34. Progress Meetings will be held bi-weekly or as needed and a representative from each Subcontractor whose work will be starting in the next two weeks is required to attend. After the initial meeting the Subcontractors representative will be required to attend all Progress Meetings until 1 month after the Subcontractors work is completed or Final Completion is met whichever is first. The CM may call for a Subcontractor to come ahead of or after the Subcontractors initial/last meeting date if deemed necessary. **The representative in attendance must be able to speak for and make decisions on behalf of the Subcontractor Company.**
35. The Subcontractor must be able to maintain sufficient manpower, tools, equipment etc. to meet the Construction Schedule including overtime, night, weekend, holiday work, etc.
36. Cold Weather/Hot Weather Protection as required is to be included.
37. Time lost due to weather conditions must be made up by Subcontractors.
38. The Subcontractor, at all times, must have on site a Competent Person, Superintendent or Foreman whom which the CM can discuss day to day activities and who has the authority to make company level decisions concerning manpower, equipment and material for their Scope of Work.
39. Parking will only be allowed in designated areas as approved by the CM.
    a. Light Duty Trucks, Vans, SUV's and Cars will be only allowable vehicles.
    b. Any unauthorized parking will result in a $100.00 fine multiplied per offense up to 3, where-in after the subject vehicle will be towed at the vehicle owner's expense.
40. A Designated area for consumption of food and beverages may be established by the CM for use by all subcontractors and their employees. Trash/debris generated during consumption is to be deposited in dumpsters/trash receptacles by the Consuming Subcontractor and their employees prior to leaving this area. No radios will be allowed on site at any time.

41. Temporary lay-down area/Storage area will be located as directed by the CM. Space is limited and may be on a first come first served basis at the discretion of the CM. Any exterior containers, trailers or other storage devices are the sole responsibility of the Subcontractor.
42. Delivery of materials for the Subcontractor is to be done by the Subcontractor having sufficient forces on site to offload so at the time of delivery.
43. Subcontractors are required to do their own take-off for their scope of work and not rely on any quantities stated or shown on plans.
44. All spoils created by Bid Package Subcontractors are to be removed from the project site. The CM is not responsible for ANY spoils removal.
45. All Subcontractors are responsible for their own licenses that may be required by State, Local or Federal Jurisdictions' before any work on this project may commence. Any and all costs for license(s) will be paid by the subcontractor.
46. All Subcontractors are responsible for procurement and purchasing any and all licenses, permits, tap fees, special inspections, other fees with-in their Bid Package.
47. Storage of material inside of any building is prohibited unless approved by the CM. See item # 10.
48. The Bid Packages, as compiled, including specification sections and verbiage are to be bid as a complete system, including all components for the complete system. When work is associated with a specific bid package but the associated specification section is not listed in the bid package it is the same as if the section was listed.
49. The Owner and CM reserve the right to reject any and all bids.
50. The CM will only award agreements/contracts/PO's based on the lowest responsible qualified proposal, provided it is in the best interest of the Owner and/or CM.
    a. To determine the lowest responsible qualified proposal the CM will evaluate proposals based on at least the following considerations:
        i. Total amount of proposal including Base Bid and Alternate Bids
        ii. Completed Bid Form
        iii. Bidders bonding rate and capacity
        iv. Sufficiency of Bidders financial resources
        v. Evaluation of Bidders labor rates and available manpower, personnel and other resources.
        vi. Bidders ability to perform in accordance with the Contract Documents
        vii. Bidders history of performance working under the CM
        viii. Evaluation of Bidders Safety Record
        ix. Bidders history of compliance with applicable laws, codes, rules, regulations
        x. Past, Current or Pending litigation and the amounts and nature there-in
51. A Post bid interview may be required of Subcontractors at the discretion of the CM. Those Subcontractors that the Post-Bid Interview is deemed required of will be contacted with-in 48 hours after Bid opening with specifics on the meeting.
52. It is the responsibility of the Subcontractor to be aware of the project in its entirety including all other bid packages and the inclusions and exclusions there-in.
53. Any discrepancies, questions or RFI's of any sort in Bid Packages, Plans, Specifications etc., are to be asked in written form either e-mail or mail to the attention of the CM/Architect per the Project Documents.
54. By providing and signing the Bid Form you hold RE Smith Construction and its employees harmless and agree to all terms as set forth on the Bid Form and in the plans and specifications of which this document is a part.
55. No price escalations increases will be accepted after bids are received. No exceptions.
56. All work is subject to Prevailing Wage Rates.

57. Applying material to a surface is an acceptance of the substrate. If a substrate is unacceptable in your opinion, contact the project superintendent prior to placing material on it.
58. **No exclusions to bid packages will be allowed.** Do not include any documentation with your bid, other than what is directed by the specifications.
59. **Phase construction will be as the following –** storm drain piping will be installed prior to site work starting – site work, including lime stabilization of the building pad, ECC parking lot and the private road – all building related work for the ECC – Hubble parking lot work will not start until June 2022. All bid packages must include additional mobilizations to accomplish the proposed phasing.

Bid Package 03
Concrete

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Concrete** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements
Division 01 – General Requirements
Division 03 – Concrete
Section – 03 30 00 Cast In Place Concrete
Section – 03 05 16 Underslab Vapor Barrier
Division 07 – Thermal & Moisture Protection
Section – 07 21 00 Thermal Insulation
As it applies to below grade insulation.
Section – 07 92 00 Joint Sealants
As it applies to joint filler of saw joints in slabs
Section – 07 95 00 Expansion Joint Cover Assemblies
As it applies to cast in place floor expansion joint assemblies, if required.
Division 13 –Special Construction
Section – 13 34 19 Metal Building Systems
As it applies to cast in place anchor bolts
Division 31 – Earthwork
Section – 31 23 00 Excavation and Fill
As it applies to the scope of work in this bid package.
Section – 31 31 16 Termite Control
Division 32 – Exterior Improvements
Section – 32 11 00 Cast-In-Place Concrete for Sitework
Section – 32 13 73 Concrete Paving Joint Sealants

Additional bid package requirements:

1. Hoisting of all materials.
2. Layout of all building concrete items embedded in concrete and architectural and structural control and expansion joints in concrete applications. CM will provide control points and benchmarks only.
3. Cold and hot weather requirements, including hot water /ice in concrete mixes and protection of concrete items to maintain the project schedule.
4. All bracing as needed/required.
5. Providing/installing all required reinforcing, including supports such as chairs and weldable couplers.
6. Offsite removal of all spoils created by this bid package. .
7. Include all required concrete pumping.
8. Joint filling of all saw joints in slabs.
9. Include the installation of all structural steel anchor bolts. BP 05 subcontractor will furnish the material.
10. Include all base rock under the slab and at wall backfill. Only base rock may be used as wall backfill.
11. Include the perimeter drain around the building with base rock backfill. Drain shall terminate 5’-0” from building where it will be extended by BP 31 to tie into the storm drain system as shown on the documents.

12. Includes the installation of all pipe bollards. Pipe bollard material will be furnished by BP 05.
13. Includes the installation of 280 ¾" x 18" anchor bolts. Anchor bolt material will be furnished by BP 05.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 04

Masonry

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Masonry** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 03 – Concrete

Section - 03 45 00 Precast Architectural Concrete

Division 04 – Masonry

Section – 04 05 11 Mortar and Masonry Grout

Section – 04 20 00 Masonry Veneer

Section – 04 22 00 Unit Masonry

Section – 04 26 16 Adhered Masonry Veneer

Division 05 – Metals

Section – 05 12 00 Structural Steel Framing

As it applies to installing embeds in masonry.

Section – 05 31 00 Steel Decking

As it applies to installing embeds in masonry.

Division 07 – Thermal & Moisture Protection

Section – 07 21 00 Thermal Insulation

As it applies to foam in place insulation at CMU walls and polyiso insulation behind all masonry items.

Section – 07 95 00 Expansion Joint Cover Assemblies

As it applies to wall to wall, wall corner, wall to ceiling joint systems in masonry walls.

Division 08 – Doors and Windows

Section – 08 11 13 Hollow Metal Doors and Frames

As it applies to grouting hollow metal frames in all masonry walls.

Additional bid package requirements:

1. Hoisting of all materials.
2. Layout of all masonry walls, embeds in masonry and architectural and structural control and expansion joints in masonry applications. CM will provide control points and benchmarks only.
3. Cold and hot weather requirements, including enclosures and protection of masonry to maintain the project schedule.
4. All bracing as needed/required.
5. Includes all grouting of HM frames as shown or specified regardless of the frame location.
6. Multiple brick mock ups may be required.
7. Include all reinforcing for masonry work.
8. Masonry debris will be hauled off site. Excessive masonry debris will not be allowed in the construction dumpsters.
9. Include the installation of all steel embed items and lintels that are placed in masonry/brick walls. BP 05 will furnish these items.
10. All electrical boxes in masonry walls shall be cut tight to the box. No gaps will be allowed.
11. Interior masonry walls shall be rubbed and cleaned so that the primed surface is per the acceptable final finish. Any wall that is not properly cleaned and rubbed prior to primer being applied will have to be rubbed and back charges issued for new primer.

12. Bracing at the Safe Room CMU walls need to be left in place until the structural steel has been installed. Steel could be delayed for up to several months after masonry is completed.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 05
Structural Steel

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Structural Steel** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements
Division 01 – General Requirements
Division 05 – Metals

Section – 05 12 00 Structural Steel Framing
Section – 05 31 00 Steel Decking

Additional bid package requirements:

1. Erection of all steel and steel related items, with the exception of items that are embedded in cast in place concrete and masonry, such as lintels and anchor bolts. These items will be provided under this bid package, but installed under separate bid packages.
2. All decorative and pipe and tube railings, regardless of location, will be furnished and installed under this bid package.
3. Layout of all steel and steel related items. CM will provide control points and benchmarks only.
4. Includes all required field verification of all steel and steel related items, including handrails.
5. This bid package to include all connections, including steel to steel and steel to concrete.
6. Hoisting of all materials.
7. Include all pipe bollards. Bollards will be installed by the BP 03 subcontractor.
8. Includes the furnishing of 280 ¾" x 18" anchor bolts. Anchor bolts will be installed by BP 03 subcontractor.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 06

Millwork

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Millwork** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07 – Thermal & Moisture Protection

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 06 – Wood, Plastics and Composites

Section – 06 20 00 Finish Carpentry

Division 12 – Furnishings

Section – 12 32 00 Manufactured Wood Casework

Section – 12 36 00 Countertops

Additional bid package requirements:

1. Bid package will include furnishing and installation of all millwork, solid surface including integral sinks in bathroom vanities if shown.
2. Hoisting of all materials.
3. Furnish and install all countertop brackets.
4. Furnish and Install all 2x bases for all Millwork.
5. All cabinets/millwork shall be cleaned inside and out upon completion of installation. This includes removal of all sawdust.
6. Bid package includes all countertops, regardless of material, such as stainless steel, quartz, plastic laminate and solid surface.
7. Include all solid surface window sills.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 07

TPO Roofing

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **TPO Roofing** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07- Thermal & Moisture Protection

Section – 07 21 00 Thermal Insulation
Section – 07 54 00 Thermoplastic Membrane Roofing
Section – 07 62 00 Sheet Metal Flashing and Trim
Section – 07 71 00 Roof Specialties
Section – 07 72 00 Roof Accessories

Additional bid package requirements:

1. Hoisting of all materials.
2. Layout of all related items. CM will provide control points and benchmarks only.
3. Cold weather requirements, including enclosures and protection of building finishes during this scope of works process.
4. Include all roof accessories such as walk pads, roof hatch, etc.
5. Include all required manufacture onsite inspections to fulfill all warranty requirements.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 07A

Waterproofing and Air Barriers

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Waterproofing and Air Barriers** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07- Thermal & Moisture Protection

Section – 07 14 00 Fluid Applied Waterproofing

Section – 07 19 00 Water Repellents

Section – 07 92 00 Joint Sealants

Additional bid package requirements:

1) Include all required hoisting, scaffolding.
2) Cold weather requirements, including enclosures and protection during this scope of works process.
3) Include all associated waterproofing work at openings as per manufactures' requirements for the specified systems.
4) Includes all caulking of the exterior of the building as well as interior masonry caulking.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 08

Storefronts/Glazing

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Storefronts/Glazing** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements Complete

Division 07 – Thermal & Moisture Protection

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 08 – Doors and Windows

Section – 08 06 71 Door Hardware Schedule

As it applies to aluminum doors, including automatic door operators.

Section – 08 43 13 Aluminum-Framed Storefronts

Section – 08 71 00 Door Hardware

As it applies to aluminum doors, including automatic door operators.

Section – 08 80 00 Glazing

Section – 08 87 19 Security Glazing Film

Additional bid package requirements:

1. Provide Hardware complete per Sections above for Storefronts.
2. Coordinate the automatic door controls with the access control subcontractor, as well the BP 26 subcontractor. A mandatory onsite coordination meeting will be held prior to the installation of the storefront framing to ensure that all pathways are available and that electrified door hardware is compatible with the automatic door controls.
3. Include all required water testing as per specifications and warranties.
4. Include providing and installation of all Automatic Door Operators, as specified and as shown on the plans.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 08A

General Trades

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **General Trades** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 03 – Concrete

Section – 03 35 11 Concrete Floor Finishes

Division 07 – Thermal & Moisture Protection

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 08 – Doors and Windows

Section – 08 06 71 Door Hardware Schedule

Section – 08 11 13 Hollow Metal Doors and Frames

Section – 08 14 16 Flush Wood Doors

Section – 08 33 13 Coiling Counter Doors

Section – 087100 Door Hardware (excluding hardware for aluminum framed entrances)

Division 09 – Finishes

Section – 09 05 61 Common Work results for Flooring Preparation

As it applies to Concrete Floor Finishes and Resinous Flooring

Section – 09 67 00 Fluid Applied Flooring

Division 10 – Specialties

Section – 10 11 00 Visual Display Units

Section – 10 14 00 Signage

Section – 10 21 13.19 Plastic Toilet Compartments

Section – 10 26 01 Wall and Door Protection

Section – 10 28 00 Toilet, Bath and Laundry Accessories

Section – 10 44 00 Fire Protection Specialties

Section – 10 56 17 Wall Mounted Standards and Shelving

Section – 10 75 00 Flagpoles

Division 12 – Furnishings

Section – 12 24 00 Window Shades

Division 32 – Exterior Improvements

Section – 32 17 23 Pavement Markings

Section – 32 92 00 Turf and Grasses

Additional bid package requirements:

1. Hoisting of all materials.
2. Include the project sign; see section 015000 Temporary Facilities and Controls.
3. Include site enclosure fencing; see section 015000 Temporary Facilities and Controls.
4. Include final project cleaning.
5. Include all pre-cast wheel stops, striping, and pre-manufactured speed bumps.
6. Include all traffic and ADA site signage.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 09

Metal Studs/Gyp Board/Ceilings

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Metal Studs/Gyp Board/Ceilings** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 05 – Metals

Section – 05 40 00 Cold-Formed Metal Framing

Division 06 - Woods and Plastics

Section – 06 10 10 Non-Structural Rough Carpentry

Section – 06 20 00 Finish Carpentry

Division 07 – Thermal & Moisture Protection

Section – 07 21 00 Thermal Insulation

As it applies to the scope of work in this bid package.

Section – 07 21 19 Foamed-in-Place Insulation

Section - 07 21 26 Blown Insulation

Section – 07 25 00 Weather Barriers

Section – 07 81 00 Applied Fire Protection

Section – 07 84 00 Firestopping

As it applies to the scope of work in this bid package.

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Section – 07 95 13 Expansion Joint Cover Assemblies

As it applies to wall to wall, wall corner, wall to ceiling and ceiling to ceiling joint systems.

Division 09 – Finishes

Section – 09 21 16 Gypsum Board Assemblies

Section – 09 22 16 Non-Structural Metal Framing

Section – 09 30 00 Tiling

As it applies to tile backer board.

Section – 09 51 00 Acoustical Tile Ceilings

Section – 09 84 33 Sound-Absorbing Wall and Ceiling Units

Additional bid package requirements:

1. Hoisting of all materials.
2. Include Painted/Vinyl Stencil of Fire Walls/Smoke Walls as required on sheetrock.
3. Includes all wood blocking for the entire project. As well as the plywood on the walls in the specified MEP rooms.
4. All electrical boxes will be either covered or cleaned out of excess drywall compound prior to the painter starting work. All electrical boxes that are not cut tight to the drywall shall be patched prior to the painter starting work. Gaps between the electrical box that are visible after the wall plate is installed shall be patched and if the wall has already been painted, back charges will be issued for repainting.
5. BP 09 subcontractor will be required to provide adequate manpower to work in multiple phases during construction. For example, separate crews to work on exterior metal studs, exterior sheathing, interior metal studs and gypsum board all at the same time.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will

be identified as non-responsive.

Bid Package 09A

Flooring

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Flooring** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07 – Thermal & Moisture Protection

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 09 – Finishes

Section – 09 05 61 Common Work Results for Flooring Preparation

Section – 09 30 00 Porcelain Tiling

Section – 09 65 00 Resilient Flooring

Section – 09 65 66 Resilient Athletic Flooring

Section – 09 68 13 Tile Carpeting

Additional bid package requirements:

1. Layout of all flooring and related items, including expansion joints in floor applications.
2. Includes all required floor patching, leveling and grinding as needed whether indicated or not.
3. Includes waxing/sealing of floor products as per the specifications.
4. Include floor protection as required by specifications.
5. Include all flooring transitions and base.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 09B

Painting

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Painting** as required per the contract documents, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07 – Thermal & Moisture Protection

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 8 – Doors and Windows

Section – 08 11 13 Hollow Metal Doors and Frames

As it applies to the bondo-izing of hollow metal door frames in CMU walls that will require holes drilled for grouting. Repair to ensure a smooth surface prior to priming and painting.

Division 09 – Finishes

Section – 09 72 00 Wall Coverings

Section – 09 91 13 Exterior Painting

Section – 09 91 23 Interior Painting

Additional bid package requirements:

1. Includes the protection of all flooring, walls, doors, frames, fixtures and devices during the painting process.
2. Includes, but not limited to, the caulking of interior door frames, and the interior joint between windows and drywall.
3. BP 09B subcontractor will be required to inspect all surfaces prior to applying paint to them. After paint is applied the subcontractor has accepted the substrate.
4. If spot painting does not match adjacent areas, BP 09B subcontractor will be required to paint the entire surface, either wall or ceiling, to the next inside corner.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 13

PEMB Erection/Misc Materials

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **PEMB Erection/Misc Materials** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 13 – Special Construction

Section – 13 34 19 Metal Building Systems

As it applies to the unloading and erection of the pre-supplied PEMB.

Additional bid package requirements:

1. Includes providing all required labor and equipment to erect the pre-supplied PEMB.
2. Includes furnishing and installing all PEMB roof insulation.
3. Includes furnishing and installing all exterior insulated metal wall panels.
4. Includes furnishing and installing all required roof mounted snow guards.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 21

Fire Sprinkler

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Fire Sprinkler** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07 – Thermal & Moisture Protection

Section – 07 84 00 Firestopping

As it applies to the scope of work in this bid package.

Division 21 – Fire Suppression – All Sections

Division 22 – Plumbing

As it relates to coordination and other requirements.

Division 23 – HVAC

As it relates to coordination and other requirements.

Division 26 – Electrical

As it relates to coordination and other requirements.

Division 27 – Communications

As it relates to coordination and other requirements.

Additional bid package requirements:

1. This bid package will include all related fire suppression items from 1'-0" above finish floor.
2. Bid shall include any additional fire sprinkler requirements, such as heads and piping, in the Multi-Purpose Room, so that the code requirements can be fulfilled without changing the layout shown for items such as lights, HVAC ductwork and lapendary ceiling panels. If more heads/piping are required to provide coverage, they shall be included in the bid package.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 22

Plumbing

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Plumbing** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 02 – Demolition

Section – 02 41 13 Site Demolition

As it applies to related scope of work in this bid package.

Division 03 – Concrete

Section – 03 30 00 Cast in Place Concrete

As it applies to thrust blocks for underground piping.

Division 07 – Thermal & Moisture Protection

Section – 07 84 00 Firestopping

As it applies to the scope of work in this bid package.

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 21 – Fire Sprinkler

As it relates to coordination and other requirements.

Division 22 – Plumbing – All Sections

Division 23 – HVAC

As it relates to coordination and other requirements.

Division 26 - Electrical

As it relates to coordination and other requirements.

Division 27 – Communications

As it relates to coordination and other requirements.

Division 31 – Earthwork

Section – 31 23 00 Excavation and Fill

As it applies to the scope of work in this bid package.

Division 33 – Utilities

Section – 33 05 26 Utility Identification

Section - 33 31 00 Sewer Utility Sewerage Piping

Section – 33 39 00 Sewer Utility Drainage Structures

Additional bid package requirements:

1. Include all required permits, tap fees and impact fees.
2. Offsite removal of all spoils generated by this bid package.
3. Include all required access panels as needed as they relate to Plumbing.
4. All condensate piping is to be included in this bid package starting at the unit.
5. Furnish and install sleeves of sufficient size for new underground piping to pass through where required through/under new concrete as required for plumbing items.
6. Include all trenching, backfilling, compaction as required for all related below grade plumbing operations complete.
7. Includes all site water, sanitary sewer and propane gas lines complete.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 23

HVAC

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **HVAC** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 07 – Thermal & Moisture Protection

Section – 07 84 00 Firestopping

As it applies to the scope of work in this bid package.

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 21 – Fire Sprinkler

As it relates to coordination and other requirements.

Division 22 – Plumbing

As it relates to coordination and other requirements.

Division 23 - HVAC – All Sections

Division 26 - Electrical

As it relates to coordination and other requirements.

Division 27 – Communications

As it relates to coordination and other requirements.

Additional bid package requirements:

1. This Bid Package Contractor will provide and maintain a temporary heating and cooling system. The temp heating system will maintain a heating temperature at all times of 60 degrees and 20% RH during finishing operations. The cooling system will maintain a maximum of 80 degrees and a maximum of 65% RH during finishing operations. The NEW HVAC system may be utilized if the system is cleaned, temporary filters two MERV higher than specified are used and these filters are replaced bi-weekly during construction period and properly maintained and returned to like new conditions with no determent to warranty.
2. Include all required access panels as they relate to HVAC.
3. BP 23 subcontractor will be required to cover/protect the leading edge of all newly installed ductwork to prevent dust and dirt, or the entire system will be professional cleaned at the end of the project but prior to start up.
4. Include the insulation requirements for roof curbs as shown on the documents.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 26

Electrical

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Electrical** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 02 – Demolition

Section – 02 41 13 Site Demolition

As it applies to related scope of work in this bid package.

Division 07 – Thermal & Moisture Protection

Section – 07 84 00 Firestopping

As it applies to the scope of work in this bid package.

Section – 07 92 00 Joint Sealants

As it applies to the scope of work in this bid package.

Division 08 – Doors and Windows

Section – 08 71 00 Door Hardware

As it applies to low voltage wiring

Division 21 – Fire Sprinkler

As it relates to coordination and other requirements.

Division 22 – Plumbing

As it relates to coordination and other requirements.

Division 23 – HVAC

As it relates to coordination and other requirements.

Division 26 – Electrical – All Sections

Division 27 – Communications - All Sections

Division 31 – Earthwork

Section – 31 23 00 Excavation and Fill

As it applies to the scope of work in this bid package.

Additional bid package requirements:

1. Include all required permits, tap fees and impact fees.
2. Provide and maintain interior temporary lighting as required by provisions of OSHA CFR 1926 Subpart D standard number 1926.53 (Table D-3) and/or the specifications (Pre-Installation Conference with CM required).
3. This Bid package shall include conduit for all trades/bid packages.
4. Includes all required underground work for electrical, data and communications.
5. Install all required access panels as they relate to Electrical.
6. Furnish and install sleeves of sufficient size for new conduit to pass through where required through/under new concrete where required for electrical items.
7. Provide temporary power requirements as needed. Provide power within the building that is accessible to any location within 100' either direction. Provide a minimum of six 20 amp GFCI duplex receptacles at each end of run location.
8. Include all trenching, backfilling, compaction as required for all below grade electrical work complete.
9. Offsite removal of all spoils generated by this bid package.
10. Coordinate the automatic door control subcontractor and the access control subcontractor, as well the BP 08 subcontractor. A mandatory onsite coordination meeting will be held prior

to the installation of the storefront framing to ensure that all pathways are available and that electrified door hardware is compatible with the automatic door controls.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 31

Site Work/Site Demolition/Storm Drainage

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Site Work/Site Demolition/Storm Drainage** as required per the contract documents, common requirements, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 02 – Demolition

Section – 02 41 13 Selective Structural Demolition

As it applies to related scope of work in this bid package.

Division 31 – Earthwork

Section – 31 10 00 Site Clearing

Section – 31 23 00 Excavation and Fill

Section – 31 25 00 Erosion and Sedimentation Controls

Division 33 – Utilities

Section – 33 41 00 Storm Utility Drainage Piping

Section - 33 49 00 Storm Drainage Structures

Additional bid package requirements:

1. Includes all demolition, saw-cutting as required, capping of demolished utility lines and removal of all required concrete, storm piping, utility piping, trees, asphalt etc. identified by the contract documents. All debris from demolition will be removed from the site and will not be allowed in the construction dumpsters.
2. Include the Construction entrance complete; include maintenance and removal as directed by CM.
3. Includes the backfilling of all site concrete items, such as curb & gutter, walks and concrete flumes.
4. Include furnishing, placing and machine grading of all required topsoil for the landscaping of the project, including importing of topsoil from offsite if required.
5. Includes the furnishing, installation, maintenance and removal of all erosion control requirements, including install and removal of construction entrance, filing and payment of DNR permit.
6. Include all required permits, tap fees and impact fees.
7. This contractor will be required as directed by CM to do “re-grading touch-up” periodically which will entail smoothing of ruts made by others equipment, light vehicle travel, other miscellaneous disturbance of subgrade soil and minor regarding as needed. Re-grading touch-up may involve the entire site or be localized areas.
8. **Complete** Site subgrade is to be achieved per schedule and prior to initial de-mobilization by this Subcontractor with emphasis being put on the completion of the building pad.
9. BP 31 subcontractor will be required to furnish a 3rd party grade certification report for all subgrades at hard surfaces. Hard surfaces include asphalt paving, concrete curb and gutter, sidewalks, concrete paving and the building pad. After each area has been certified that it was installed to grade as per the contract documents, any damage to the grades will be the responsibility of the damaging subcontractor. All cost for the grade certification will be the responsibility of the BP 31 subcontractor and all reports will be sent to the design team, owner and the CMR.

10. Offsite removal of all spoils generated by this bid package.
11. Include tying into the building perimeter drain system 5'-0" from the building (By BP 03) and extending it into the storm drain system as shown on the documents.
12. Include downspout drainage system complete. BP 13 will terminate the downspout 6" below final finish grade. BP 31 will furnish and install the adapter boot and all associated piping from the downspout to the final tie into the storm drainage system.
13. Include the lime stabilization as per the Geo Tech Report as well as information in the specifications and drawings. Allow for additional mobilizations for the Hubble parking lot to be completed from June 1st, 2022 to August 1st, 2022.
14. Include the sawing of the existing Hubble parking lot for utilities to be installed.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

Bid Package 32

Asphalt Paving

Provide all material, labor, equipment, tools, supervision and other items necessary to complete all **Asphalt Paving** as required per the contract documents, bidding documents, this Scope of Work, and other items as issued by Addenda. Contract specifically includes, but is not limited to, the following:

Division 00 – Bidding & Contract Requirements

Division 01 – General Requirements

Division 32 – Exterior Improvements

Section – 32 12 16 Asphalt Paving

Section – 32 13 73 Concrete Paving Joint Sealants

Additional bid package requirements:

1. This bid package includes furnish and install per AHJ of all crushed stone under all asphalt paving and concrete curb and gutter when shown.
2. Include 1,000 sqft of asphalt patch to be used at the CM's direction.
3. Include all concrete curb and gutter, with associated reinforcing.
4. Include asphalt speed humps.
5. BP 31 subcontractor will backfill completed walks, concrete paving and curb and gutter.
6. Include a minimum of 3 mobilizations.

No exclusions to a bid package will be allowed. If any exclusions are listed on a bid form, the bid will be identified as non-responsive.

END OF SECTION 002000

00 21 13 INSTRUCTION TO BIDDERS

I. GENERAL:

A. **AIA Document A701, "Instruction to Bidders–2018 Edition"** as published by the American Institute of Architects are hereby, except as may be inconsistent herewith, made part of these Bidding Documents. These **Instructions to Bidders** apply equally to and are part of all Bidding Documents between the Owner and each Contractor for Work under this Project.

II. SPECIAL NOTICE TO BIDDERS:

A. These Specifications have bound hereto a complete set of bidding and contract forms. One complete signed set of bid forms as detailed in the Bid Forms Article shall be submitted in a sealed envelope plainly marked identifying the project and the bidder.

III. BID FORM

A. The Bid Form shall be enclosed within a sealed envelope labeled **Bid Form** noting the **Project Title, Bid Package and time for bid opening.** Bid documents sent via mail shall be sealed within two envelopes (inner and outer), with the outer envelope addressed for the Project and marked "Sealed Bid Enclosed" on the face thereof, and with the inner envelope sealed and clearly labeled as described above.

B. The OWNER may consider informal any bid not prepared and submitted in accordance with the provisions hereof. The OWNER reserves the right to waive minor technicalities and to reject any and all bids. Any bid received after the time and date specified shall not be considered.

C. Each bid must be submitted on the **Bid Form** (Appendix A). All bids shall be submitted without modification or reservation on the bid form with each space properly filled. All blank spaces for bid prices must be filled in, in ink or typewritten, in both written and numeric, and the foregoing Certifications must be fully completed and executed when submitted.

   i. In the event of discrepancies within bidding documents, the written words will take precedence over the numeric presentation of the bid. If written words are absent from bid form, it will be considered an unresponsive bid.

D. No contractor shall stipulate in their proposal any conditions not contained in the specifications or standard proposal form contained in the Contract Documents. Such submission may be a cause for rejection of bid.

E. No telephonic, telegraphic, electronic mail, facsimile (FAX), or similar bid transmissions will be accepted or allowed. Copies of forms may be made but original signatures must be on the forms at the time of the submission on the bid proposal. Bidders must sign all forms and it is encouraged that a color other than black ink be used. Any modifications to bid shall be made as set forth within the Modifications and Withdrawals of Bids section.

F. Bidders shall include the following bid forms at the time of bid submission. Failure to do so may result in rejection of bid.

   i. Signed Bid Form (Appendix A)
   ii. E-Verify (Appendix A)

IV. INTERPRETATIONS AND ADDENDA

A. No oral interpretations will be made to any bidder as to the meaning of the Contract Documents.

B. Every request for interpretation shall be submitted in writing addressed and forwarded to **Kirsten M. Whitehead, whitehead@paragonarchitecture.com**
   i. Submit requests a minimum of **7 business days** prior to date of receipt of Bids.
   ii. Anticipated release of Final Addenda: **5 business days** prior date of receipt of Bids.

C. Every interpretation made to the bidder will be in the form of an addendum and will be sent through the plan room listed in the Notice to Bidders. All addenda shall become part of the Contract Documents.

D. Any discrepancy, conflict, ambiguity, error or issue which may have more than one interpretation, should be forwarded to the Architect who may make the interpretation. In absence of an interpretation, issued by Addendum, the default position shall be for the bidder to bid the more restrictive and/or more costly interpretation which gives the Owner the option of either.

V. EXAMINATION OF DOCUMENTS AND AREA OF WORK

A. Prior to bid, each bidder shall examine the Contract Documents carefully. Each bidder must carefully examine the entire limits of construction and surrounding area and shall make necessary investigations to be fully informed of the conditions relating to the construction of the Project and the employment of labor. Failure to do so will not relieve a successful bidder of the obligation to furnish all material and labor necessary to carry out the provisions of the contract. To the extent possible, the contractor, in carrying out the work, must employ such methods or means as will not cause any interruption or interference with the work of any other contractor.

B. Contract Documents are not set up for specific trades and all Contractors and Subcontractors are required to review all drawings and specifications and must complete the work as shown on all portions of the contract documents. Each trade is required to review all portions of the Contract Documents including Drawings and Specifications.

VI. STATEMENT OF QUALIFICATIONS

A. Each bid must be accompanied by a **Statement of Qualification** using the form furnished in Appendix A.

B. The Owner shall have the right to take such steps as it deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as may be requested. The Owner reserves the right to reject any bids where the 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.

C. All professional service contracts and construction contracts arising from this work must use firms/businesses that are licensed to operate in the jurisdiction where the Project is located. No funds will be released to pay businesses that do not hold this license. All businesses involved with this project must be licensed and in good standing with the **Missouri** Secretary of State's Office.

VII. ALLOWANCES

A. Allowances shall be contained in the Construction Managers overall GMP and incorporated into the contract. Allowances contained in the contract's original proposal are understood to include the Contractor's overhead and profit and are valid thru the duration of the contract.
B. Please refer to **Section 01 21 00 Allowances** for more information.

VIII. UNIT PRICES

A. Unit prices shall be contained in the Contractor's original proposal and incorporated into the contract. Unit prices contained in the contract's original proposal are understood to include the Contractor's overhead and profit and are valid thru the duration of the contract.
B. Please refer to **Section 01 22 00 Unit Prices** for more information.

IX. ALTERNATIVE BIDS

A. No alternative bids except those called for will be considered.
B. All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

X. APPROVE EQUAL AND SUBSTITUTION POLICY

A. Any request for substitutions by the Contractor, or on behalf of any subcontractor or material supplier, shall be submitted to the Architect at least ten days prior to the date for receipt of Bids on the attached **Request for Substitution** form in Appendix B. If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. No substitutions will be considered after the contract award unless specifically provided in the Contract Documents.
B. Please refer to **Section 01 25 00 Substitution Procedures** for more information.

XI. TIME FOR RECEIVING BIDS

A. The time and location for receiving bids shall be as noted in the **Section 00 01 13 Advertisement for Bids.**
B. Bid received prior to the time of the opening will be securely kept, unopened. The office whose duty it is to receive bids will decide when the specified time has arrived, and no bid received thereafter will be considered. No responsibility will attach to any office for the premature opening of a bid not properly addressed and identified.
C. Bidders are cautioned to allow ample time for transmittal of bids by mail or otherwise. If a bid is mailed, bidders should secure correct information relative to the probable time of arrival and distributions of mail at the place where bids are to be received, and make due allowance for possible delays.
D. Bidder's attention is directed to the fact that no bid will be accepted or considered if submitted after the specified time for receiving bids.

XII. MODIFICATIONS AND WITHDRAWAL OF BIDS

A. Modification or correction of previously submitted bids may only be submitted by letter or in-person prior to the scheduled time for the receipt of bids. Modifications or corrections must be clearly marked with bid date, project title, and received by the Owner prior to the scheduled closing time for the receipt of bids in accordance with following provisions:
   i. To maintain bid confidentiality and ensure assignment to the proper bid, any such written request must be contained in a sealed envelope that is plainly marked "Modification of Bid on (Project Title and bid date)".
   ii. All modifications to bids shall be provided from a verifiable source of those submitting the bid.
   iii. A bidder may withdraw their bid at any time prior to the scheduled closing time for the receipt of bids or authorized postponement thereof, but no bidder may withdraw their bid for the period stated within the Bid Proposal after closing time for the receipt of bids. Request to withdraw bid must be made in-person or by written request.
   iv. No bidder may withdraw their bid for a period of **thirty (30)** calendar days after the date set for opening thereof, and bids shall be subject to acceptance by the Owner during this period.

XIII. AWARD OF CONTRACT

A. It is reasonably expected that a contract will be awarded and signed with **seven (7)** days of bid opening, but no later than **thirty (30)** days, and that the Work shall commence as indicated in the contract (Appendix B).
B. It is the intent of the Owner to award a contract to the lowest responsive qualified bidder complying with the conditions of the Contract Documents, providing that the bid is reasonable and it is in the interest of the Owner to accept the same. The bidder to whom an award is made will be notified at the earliest possible date.
   i. The Owner, however, reserves the right to reject any and all bids and to waive any or all informalities in bids received whenever such rejection or waiver is in the interest of the Owner.
C. The Contract Sum will be determined by the sum of the base bid, and/or the sum of any or all bid alternates, in any order, which the Owner may choose to add or delete from the base bid.
D. The successful bidder shall execute the contract with the Owner in the form of the draft contract included within Appendix B.

XIV. CONTRACT PERFORMANCE AND PAYMENT BOND

A. The bonds in an amount at least equal to 100% of the total amount of the contract guaranteeing the full and prompt completion of the work and performance of the contract and for the payment of all labor and material and be made payable to OWNER.
   i. The bidder shall deliver the required bonds to the Owner not later than **3 days** following the date of execution of the Contract.

XV. CONSTRUCTION TIME AND LIQUIDATED DAMAGES

A. The contract requires work to be Substantially Completed no later than the date shown on the **Section 00 01 13 Advertisement for Bids.**
B. **PROJECT SPECIFIC: The Owner requires the Contractor to coordinate all work and cooperate with the Owner regarding partial occupancy for purpose of installing furniture and equipment, and prepping of floors and spaces for full occupancy.**
C. Liquidated Damages**:** refer to Owner-Contractor contract.

XVI. SUBCONTRACTS

A. The Bidder is specifically advised that any person, for, or other party to whom it is proposed to award a subcontract under this contract must be acceptable to the Owner.
B. See Bid Form for Subcontractor List that must be submitted with bid.
C. The Contractor shall list all subcontractors performing the work listed on the Subcontractor List regardless of the amount of work performed.
D. If the General Contractor plans to use its own forces for any portion of the work noted in the categories, then the General Contractor must list itself. Failure to list a subcontractor or the General Contractor may result in a rejection of bid as non-responsive.

XVII. PERMITS, FEES, SPECIAL INSPECTIONS, TAX EXEMPTION and WAGE RATES

A. The Contractor is responsible for trade permits, tap fees and temporary utility installation, and inspections required of the AHJ; these fees shall be included in the contract and paid by the Contractor.
B. The Owner is responsible for building permit fees, plan review fees, utility service charges, special inspections and third party material testing. The Owner shall bear the costs of test, inspections, or approvals that arise as the result of a change in laws or regulations that do not become effective and that the parties are not aware of until after bids are received or negotiations concluded.
C. The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the contract throughout, and they will be deemed to be included within the contract the same as though herein written out in full. These include State of Missouri RSMo 285.530, (1) No business entity or employer shall knowingly employ, hire for employment, or continue to employ unauthorized alien to perform work within the State of Missouri.
D. The Owner will exercise their tax-exempt status and require that the bid amount NOT include sales tax on materials. Any materials the Contractor wishes to exempt sales tax may be purchased by the Contractor/Subcontractor by authorization from the Owner via a Project Exemption Certification, which is provided within Appendix B.
E. The Project must comply with Prevailing Wage Laws, see Appendix B.

XVIII. MATERIALS AVAILABILITY

A. Prior to bidding, the Contractor shall confirm that all major materials, suppliers and subcontractors, which may impact the critical path of the Construction Schedule, are able to be delivered and/or provided such that the project schedule and substantial completion

date are not adversely affected. The Contractor shall immediately notify the Architect of any such conflicts and adversities, prior to issuance of the final addendum, prior to bidding.

B. The Contractor bears sole and full responsibility for compliance with terms of the contract for time and completion.

XIX. SAFETY STANDARDS AND ACCIDENT PREVENTION

A. With respect to all work performed under this contract, the contractor shall comply with safety standards, provisions, applicable laws, building and construction codes and the "Manual of Accident Prevention in Construction" published by the Associated General Contractors of America, the standard OSHA regulations and any other Federal, State or municipal regulations.
   i. All on-site employees of the Contractor and subcontractors are required to complete the ten hour OSHA training program.

B. All workers on the Project will be expected to dress neatly wearing shirts with sleeves, bearing the logo of the employing company. Hard hats will be worn at all times. Tobacco products and other controlled substances are not permitted on the property.

XX. INSURANCE REQUIREMENTS

A. Provide equal coverage as Construction Manager.

XXI. ADVERSE WEATHER CONDITIONS

A. Time extensions for unusually severe weather. This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the Construction Agreement. In order for a time extension to be approved under this clause, the following conditions must be satisfied:
   i. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.
   ii. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

B. The following schedule of monthly anticipated adverse weather delays shall constitute the base line for monthly weather time evaluations. The contractor's schedule shall include these anticipated adverse weather delays in all weather-dependent activities. Contractor acknowledges that there will be delays in which work cannot be completed due to the weather and that a certain number of lost days are to be expected under normal weather conditions. For projects less or more than a calendar year, lost weather days shall be prorated for the months of construction in accordance with the following schedule. Anticipated weather days for allocation/proration only.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
5	5	4	4	3	3	2	2	3	4	4	5

C. Upon acknowledgement of the Notice to Proceed and continuing throughout the contract, the contractor shall record on the daily reports, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical path activities for 50 percent or more of the contractor's scheduled work day.

D. The number of actual adverse weather delays days shall include days impacted by actual adverse weather (even if weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in chart above, qualifying days may be converted to calendar days, giving full consideration for equivalent fair weather work days, and a contract amending the contract time will be authorized.

SECTION 011000 - SUMMARY

PART 1 GENERAL

1.1 PROJECT

A. Project Name: Marshfield Early Childhood Center.

B. Owner's Name: Marshfield R-I School District.

C. Architect's Name: Paragon Architecture, LLC..

D. The Project consists of the construction of an early childhood center for Marshfield School District. The facility is approximately 26,000 sf and consists of classrooms, offices, a protected multipurpose room, and other supporting spaces. Site work includes a new private road and two parking lots to serve existing Hubble Elementary and new Early Childhood Center..

1.2 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.3 CONTRACTOR USE OF SITE AND PREMISES

A. Provide access to and from site as required by law and by Owner:

1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
2. Do not obstruct roadways, sidewalks, or other public ways without permit.

B. Utility Outages and Shutdown:

1. Limit disruption of utility services to hours the building is unoccupied.
2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
3. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012000 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.
B. Documentation of changes in Contract Sum and Contract Time.
C. Change procedures.
D. Procedures for preparation and submittal of application for final payment.

1.2 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Project record documents.

1.3 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
C. Forms filled out by hand will not be accepted.
D. Submit Schedule of Values within 15 days after date of Owner-Contractor Agreement.
E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.4 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.
B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
D. Forms filled out by hand will not be accepted.
E. Execute certification by signature of authorized officer.
F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
H. Submit one of each Application for Payment.
I. Include the following with the application:
    1. Partial release of liens from major subcontractors and vendors.
    2. Certificate of Insurance and photos attesting to products stored off-site.
        a. Certificate of Insurance shall name Owner as Additional Insured.
        b. Photos should clearly show materials labeled with Owner and Project Name.
J. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.5 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
    1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
    2. Promptly execute the change.
C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any

overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.6 APPLICATION FOR FINAL PAYMENT

A. Application for Final Payment will not be considered until the following have been accomplished:

1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012100 - ALLOWANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit-cost allowances.

B. Contingency allowances.

1.2 RELATED REQUIREMENTS

A. Section 012000 - Price and Payment Procedures: Additional payment and modification procedures.

1.3 LUMP-SUM, UNIT-COST AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight and delivery to Project site.

1.4 CONTINGENCY ALLOWANCE

A. Use the contingency allowance only as directed by Architect for Owner's purposes.

B. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

C. Funds will be drawn from the Contingency Allowance only by Change Order.

D. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012200 - UNIT PRICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.2 RELATED REQUIREMENTS

A. Document Bid Form: List of Unit Prices.

1.3 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.4 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.5 MEASUREMENT OF QUANTITIES

A. Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specificed in those Sections.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to the Contractor.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

1.6 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.2 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.3 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.4 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase) Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

D. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.2 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

3.3 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request, or equivalent form. See this form for additional information and instructions.

B. Architect will consider requests for substitutions only within 60 days after date of Agreement.

C. Submit request for Substitution for Cause immedately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 60 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.

E. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.

3.4 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

END OF SECTION

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal service.
C. Preconstruction meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Coordination drawings.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Information (RFI) procedures.
J. Submittal procedures.

1.2 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: General product requirements.
B. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.
C. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.3 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
    1. Requests for Information (RFI).
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.
    7. Applications for payment and change order requests.
    8. Progress schedules.
    9. Coordination drawings.
    10. Correction Punch List and Final Correction Punch List for Substantial Completion.
    11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
    1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
    2. Contractor and Architect are required to use this service.

3. It is Contractor's responsibility to submit documents in allowable format.
4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.

B. Cost: The cost of the service will be paid by Owner.

C. Submittal Service: The selected service is:
1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com/#sle.

D. Training: At Contractor's option, FREE training is available for Submittal Exchange regarding use of website, website's services and PDF submittals. Contact Submittal Exchange for more information.

E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.2 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor.
4. Major subcontractors.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect , Owner , participants, and those affected by decisions made.

3.3 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum every two weeks intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:

1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect , Owner , participants, and those affected by decisions made.

3.4 CONSTRUCTION PROGRESS SCHEDULE - See Section 013216

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Submit updated schedule with each Application for Payment.

3.5 COORDINATION DRAWINGS

A. Review drawings prior to submission to Architect.

3.6 REQUESTS FOR INFORMATION (RFI)

A. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.

1. Prepare a separate RFI for each specific item.
    a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    b. Do not forward requests which solely require internal coordination between subcontractors.
2. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

B. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.

1. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
    a. Approval of submittals (use procedures specified elsewhere in this section).
    b. Approval of substitutions (see Section - 016000 - Product Requirements)
    c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

2. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response.

C. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

D. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

E. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.

F. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

G. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.

4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.7 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule specified in Section - 013216 - Construction Progress Schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

3.8 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data. Indicate:
      a. Manufacturer, model type and number; intended location and use; size and physical characteristics; proposed options; installation methods and accessories.
   2. Shop drawings.
      a. Drawings shall be clearly labeled with space/room names matching those on the Construction Documents.
   3. Samples for selection. Indicate:
      a. Manufacturer, model type and number; intended location and use.
   4. Samples for verification.
   5. Other types indicated.
   6. Submittals failing to clearly indicate information required above, shall be subject to immediate rejection.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.9 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
   2. Sequentially identify each item.
      a. File name shall use Specification Section number followed by a hyphen and then a sequential number (e.g., 061000-01).
      b. For revised submittals use original number, the letter "R" and a sequential numerical suffix (e.g., 061000-01 R1).
   3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   4. Identify options requiring selection by Architect or reviewer in written format.
   5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Upload submittals in electronic form to Electronic Document Submittal Service website.
   7. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
   8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   9. Identify options requiring selection by Architect or reviewer in written format.
   10. Provide space for Contractor and Architect review stamps.
   11. When revised for resubmission, identify all changes made since previous submission.

12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
14. Submittals not requested will be recognized, and will be returned "Not Reviewed",

3.13 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
   1. Submittals failing to clearly indicate information required in 3.08A, shall be subject to immediate rejection.
   2. Submittals which have not been reviewed by the Contractor prior to submission shall be subject to immediate rejection.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
   1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved", or language with same legal meaning.
      b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
         1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
      c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit".
         1) Resubmit revised item, with review notations acknowledged and incorporated.
      b. "Rejected".
         1) Submit item complying with requirements of Contract Documents.

END OF SECTION

SECTION 013216 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.2 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Submit updated schedule with each Application for Payment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.2 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.3 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.4 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals.
B. References and standards.
C. Testing and inspection agencies and services.
D. Control of installation.
E. Mock-ups.
F. Tolerances.
G. Manufacturers' field services.
H. Defect Assessment.

1.2 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittal procedures.
B. Section 014216 - Definitions.
C. Section 016000 - Product Requirements: Requirements for material and product quality.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit copies of report to Architect and to Contractor.
    1. Include:
        a. Date issued.
        b. Project title and number.
        c. Name of inspector.
        d. Date and time of sampling or inspection.
        e. Identification of product and specifications section.
        f. Location in the Project.
        g. Type of test/inspection.
        h. Date of test/inspection.
        i. Results of test/inspection.
        j. Compliance with Contract Documents.
        k. When requested by Architect, provide interpretation of results.
D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
    1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
    1. Submit report in duplicate within 30 days of observation to Architect for information.

2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.4 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.5 Testing and Inspection Agencies and Services

A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspections.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

D. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.

E. Accepted mock-ups shall be a comparison standard for the remaining Work.

F. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.4 TESTING AND INSPECTION

A. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

B. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.5 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.6 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 014216 - DEFINITIONS

PART 1 GENERAL

1.1 SUMMARY

A. Other definitions are included in individual specification sections.

1.2 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

E. Provide: To furnish and install.

F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 014219 - REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements relating to referenced standards.

1.2 QUALITY ASSURANCE

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.1 AA -- ALUMINUM ASSOCIATION, INC.

2.2 AABC -- ASSOCIATED AIR BALANCE COUNCIL

2.3 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

2.4 AASHTO -- AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

2.5 AATCC -- AMERICAN ASSOCIATION OF TEXTILE CHEMISTS & COLORISTS

2.6 ABMA -- AMERICAN BEARING MANUFACTURERS ASSOCIATION, INC.

2.7 ACA -- AMERICAN COATINGS ASSOCIATION

2.8 ACG -- AABC COMMISSIONING GROUP

2.9 ACGIH -- AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

2.10 ACI -- AMERICAN CONCRETE INSTITUTE INTERNATIONAL

2.11 ACT

2.12 ADC -- AIR DIFFUSION COUNCIL

2.13 AEIC -- ASSOCIATION OF EDISON ILLUMINATING COMPANIES

2.14 AFPA -- AMERICAN FOREST AND PAPER ASSOCIATION

2.15 AGA -- AMERICAN GALVANIZERS ASSOCIATION, INC.

2.16 AGC -- ASSOCIATED GENERAL CONTRACTORS OF AMERICA

2.17 AGMA -- AMERICAN GEAR MANUFACTURERS ASSOCIATION

2.18 AHA -- AMERICAN HARDBOARD ASSOCIATION

2.19 AHAM -- ASSOCIATION OF HOME APPLIANCE MANUFACTURERS:

2.20 AHRI -- AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE

2.21 AI -- THE ASPHALT INSTITUTE

2.22 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

2.23 AISC -- AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.

2.24 AISI -- AMERICAN IRON AND STEEL INSTITUTE

2.25 AIST -- ASSOCIATION FOR IRON AND STEEL TECHNOLOGY

2.26 AITC -- AMERICAN INSTITUTE OF TIMBER CONSTRUCTION

2.27 ALI -- AMERICAN LADDER INSTITUTE

2.28 ALSC -- AMERICAN LUMBER STANDARDS COMMITTEE

2.29 AMCA -- AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

2.30 ANSI -- AMERICAN NATIONAL STANDARDS INSTITUTE

2.31 AOSA -- ASSOCIATION OF OFFICIAL SEED ANALYSTS

2.32 APA -- APA - THE ENGINEERED WOOD ASSOCIATION

2.33 APHA -- AMERICAN PUBLIC HEALTH ASSOCIATION

2.34 API -- AMERICAN PETROLEUM INSTITUTE

2.35 API -- ALLIANCE FOR THE POLYURETHANES INDUSTRY, AMERICAN PLASTICS COUNCIL

2.36 APSP -- ASSOCIATION OF POOL & SPA PROFESSIONALS

2.37 ARI -- AIR-CONDITIONING AND REFRIGERATION INSTITUTE (See AHRI)

2.38 ARPM - ASSOCIATION FOR RUBBER PRODUCTS MANUFACTURERS

2.39 ARRA -- ASPHALT RECYCLING AND RECLAIMING ASSOCIATION

2.40 ASA -- ACOUSTICAL SOCIETY OF AMERICA

2.41 ASCA -- ARCHITECTURAL SPRAY COATERS ASSOCIATION

2.42 ASCE -- AMERICAN SOCIETY OF CIVIL ENGINEERS

2.43 ASHRAE -- AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

2.44 ASME -- THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

2.45 ASPA -- AMERICAN SOD PRODUCERS ASSOCIATION (see Turfgrass Producers International)

2.46 ASSE -- AMERICAN SOCIETY OF SANITARY ENGINEERING

2.47 ASTM A Series -- ASTM INTERNATIONAL

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

B. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

C. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

2.48 ASTM B Series -- ASTM INTERNATIONAL

A. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings 2018, with Editorial Revision.

B. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings 2018, with Editorial Revision.

C. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2012.

D. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric) 2012.

E. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2012.

F. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric) 2012.

2.49 ASTM D Series -- ASTM INTERNATIONAL

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.

B. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing 2013.

C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.

2.50 ASTM E Series -- ASTM INTERNATIONAL

A. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings 2000 (Reapproved 2006).

2.51 ASTM F Series -- ASTM INTERNATIONAL

A. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).

2.52 AWC -- AMERICAN WOOD COUNCIL

2.53 AWCI -- ASSOCIATION OF THE WALL AND CEILING INDUSTRIES INTERNATIONAL

2.54 AWI -- ARCHITECTURAL WOODWORK INSTITUTE

2.55 AWI/AWMAC/WI -- JOINT PUBLICATION OF ARCHITECTURAL WOODWORK INSTITUTE/ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA/WOODWORK INSTITUTE

2.56 AWMAC -- ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA

2.57 AWMAC/WI -- JOINT PUBLICATION OF ARCHITECTURAL WOODWORK MANUFACTURERS ASSOCIATION OF CANADA/WOODWORK INSTITUTE

2.58 AWPA -- AMERICAN WOOD-PRESERVERS' ASSOCIATION

A. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.

2.59 AWPB -- AMERICAN WOOD PRESERVERS BUREAU

2.60 AWS -- AMERICAN WELDING SOCIETY

A. AWS D1.2/D1.2M - Structural Welding Code - Aluminum 2014, with Errata.

2.61 AWWA -- AMERICAN WATER WORKS ASSOCIATION

2.62 BHMA -- BUILDERS HARDWARE MANUFACTURERS ASSOCIATION

2.63 BIA -- BRICK INDUSTRY ASSOCIATION

2.64 BIFMA -- BUSINESS AND INSTITUTIONAL FURNITURE MANUFACTURERS ASSOCIATION

2.65 ODVA -- OPEN DEVICENET VENDOR ASSOCIATION, INC.

2.66 BOMA -- BUILDING OWNERS AND MANAGERS ASSOCIATION

2.67 C2C -- CRADLE TO CRADLE PRODUCTS INNOVATION INSTITUTE

2.68 CABO -- COUNCIL OF AMERICAN BUILDING OFFICIALS:

2.69 CAGI -- COMPRESSED AIR AND GAS INSTITUTE

2.70 CARB -- CALIFORNIA AIR RESOURCES BOARD

2.71 CDA -- COPPER DEVELOPMENT ASSOCIATION, INC.

2.72 CEA -- CONSUMER ELECTRONICS ASSOCIATION

2.73 CFSEI - COLD-FORMED STEEL ENGINEERS INSTITUTE

2.74 CGA -- COMPRESSED GAS ASSOCIATION

2.75 CHPS -- COLLABORATIVE FOR HIGH PERFORMANCE SCHOOLS

2.76 CISCA -- CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION

2.77 CISPI -- CAST IRON SOIL PIPE INSTITUTE

2.78 CLFMI -- CHAIN LINK FENCE MANUFACTURERS INSTITUTE

2.79 CONSENSUSDOCS -- CONSENSUSDOCS, LLC

2.80 CPA -- COMPOSITE PANEL ASSOCIATION

2.81 CRI -- CARPET AND RUG INSTITUTE

2.82 CRRC -- COOL ROOF RATING COUNCIL

2.83 CRSI -- CONCRETE REINFORCING STEEL INSTITUTE

2.84 CSA -- CSA INTERNATIONAL (FORMERLY CANADIAN STANDARDS ASSOCIATION)

2.85 CSI/CSC -- CONSTRUCTION SPECIFICATIONS INSTITUTE/CONSTRUCTION SPECIFICATIONS CANADA

2.86 CSSB -- CEDAR SHAKE AND SHINGLE BUREAU

2.87 CTA -- CONSUMER TECHNOLOGY ASSOCIATION (FORMERLY CONSUMER ELECTRONICS ASSOCIATION)

2.88 CTI -- CERAMIC TILE INSTITUTE

2.89 CTI -- COOLING TECHNOLOGY INSTITUTE

2.90 DASMA -- DOOR & ACCESS SYSTEMS MANUFACTURERS' ASSOCIATION, INTERNATIONAL

2.91 DBIA -- THE DESIGN BUILD INSTITUTE OF AMERICA, INC.

2.92 DFI -- DEEP FOUNDATION INSTITUTE

2.93 DHI -- DOOR AND HARDWARE INSTITUTE

2.94 DIN -- DEUTSCHES INSTITUT FUR NORMUNG

2.95 EIA -- ELECTRONIC INDUSTRIES ALLIANCE

2.96 EIMA -- EXTERIOR INSULATION MANUFACTURERS ASSOCIATION

2.97 EJMA -- EXPANSION JOINT MANUFACTURERS ASSOCIATION

2.98 ETL -- ETL TESTING LABORATORY

2.99 FM -- FACTORY MUTUAL GLOBAL

2.100 GA -- GYPSUM ASSOCIATION

2.101 GANA -- GLASS ASSOCIATION OF NORTH AMERICA

2.102 GEI -- GREENGUARD ENVIRONMENTAL INSTITUTE

2.103 GREEN GLOBES -- GREEN BUILDING INITIATIVE

2.104 GREENSEAL -- GREENSEAL, INC.

2.105 HI -- HYDRAULIC INSTITUTE

2.106 HI -- THE HYDRONICS INSTITUTE (See AHRI)

2.107 HPDC -- HEALTH PRODUCT DECLARATION COLLABORATIVE

2.108 HPVA -- HARDWOOD PLYWOOD VENEER ASSOCIATION

2.109 HPW -- H.P. WHITE LABORATORY, INC.

2.110 IAPMO -- INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

2.111 IAS -- INTERNATIONAL ACCREDITATION SERVICE

2.112 ICBO -- INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

2.113 ICBO-ES -- ICBO EVALUATION SERVICE, INC.

2.114 ICC -- INTERNATIONAL CODE COUNCIL, INC.

2.115 ICC-ES -- ICC EVALUATION SERVICE, INC.

2.116 ICEA -- INSULATED CABLE ENGINEERS ASSOCIATION

2.117 ICRI -- INTERNATIONAL CONCRETE REPAIR INSTITUTE

2.118 IEC -- INTERNATIONAL ELECTROTECHNICAL COMMISSION

2.119 IEEE -- INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

2.120 IES/IESNA -- ILLUMINATING ENGINEERING SOCIETY

2.121 IGMA -- INSULATING GLASS MANUFACTURERS ALLIANCE

2.122 IGSHPA -- INTERNATIONAL GROUND SOURCE HEAT PUMP ASSOCIATION

2.123 ILI -- INDIANA LIMESTONE INSTITUTE OF AMERICA, INC.

2.124 IMIAWC -- INTERNATIONAL MASONRY INDUSTRY ALL-WEATHER COUNCIL

2.125 ISDI -- INSULATED STEEL DOOR INSTITUTE

2.126 ISFA - INTERNATIONAL SURFACE FABRICATORS ASSOCIATION

2.127 ISS -- IRON AND STEEL SOCIETY

2.128 ISSFA - INTERNATIONAL SOLID SURFACE FABRICATORS ASSOCIATION

2.129 ISO -- INTERNATIONAL STANDARDS ORGANIZATION

2.130 ITS -- INTERTEK TESTING SERVICES NA, INC.

2.131 ITU-T -- International Telecommunications Union -Telecommunication Standardization Sector

2.132 KCMA -- KITCHEN CABINET MANUFACTURERS ASSOCIATION

2.133 LIA -- LEAD INDUSTRIES ASSOCIATION, INC.

2.134 LPI -- LIGHTNING PROTECTION INSTITUTE

2.135 MBMA -- METAL BUILDING MANUFACTURERS ASSOCIATION

2.136 MFMA -- MAPLE FLOORING MANUFACTURERS ASSOCIATION

2.137 MFMA -- METAL FRAMING MANUFACTURERS ASSOCIATION

2.138 MIAMI -- MIAMI-DADE COUNTY

2.139 ML/SFA -- METAL LATH/STEEL FRAMING ASSOCIATION - See NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS

2.140 MPI -- MASTER PAINTERS INSTITUTE (MASTER PAINTERS AND DECORATORS ASSOCIATION)

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

2.141 MMSA -- MATERIALS AND METHODS STANDARDS ASSOCIATION

2.142 MSS -- MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC.

2.143 NAAMM -- THE NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS

2.144 NACE -- NACE INTERNATIONAL

2.145 NADCA -- NATIONAL AIR DUCT CLEANING ASSOCIATION

2.146 NAGDM -- NATIONAL ASSOCIATION OF GARAGE DOOR MANUFACTURERS

2.147 NAMM -- NATIONAL ASSOCIATION OF MIRROR MANUFACTURERS

2.148 NASSPA -- NORTH AMERICAN STEEL SHEET PILE ASSOCIATION

2.149 NBBI -- THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

2.150 NBGQA -- NATIONAL BUILDING GRANITE QUARRIES ASSOCIATION, INC.

2.151 NCAA -- NATIONAL COLLEGIATE ATHLETIC ASSOCIATION

2.152 NCMA -- NATIONAL CONCRETE MASONRY ASSOCIATION

2.153 NEBB -- NATIONAL ENVIRONMENTAL BALANCING BUREAU

2.154 NECA -- NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION

2.155 NEII -- NATIONAL ELEVATOR INDUSTRY, INC.

2.156 NELMA -- NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION, INC.

2.157 NEMA -- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

2.158 NETA -- INTERNATIONAL ELECTRICAL TESTING ASSOCIATION

2.159 NFHS -- NATIONAL FEDERATION OF STATE HIGH SCHOOL ASSOCIATIONS:

2.160 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

2.161 NFRC -- NATIONAL FENESTRATION RATING COUNCIL, INC.

2.162 NHLA -- NATIONAL HARDWOOD LUMBER ASSOCIATION

2.163 NIBS -- NATIONAL INSTITUTE OF BUILDING SCIENCES

2.164 NLGA -- NATIONAL LUMBER GRADES AUTHORITY (CANADA)

2.165 NOFMA -- NATIONAL OAK FLOORING MANUFACTURERS ASSOCIATION

2.166 NPA -- NATIONAL PARTICLEBOARD ASSOCIATION

2.167 NPCA -- NATIONAL PAINT AND COATINGS ASSOCIATION

2.168 NRCA -- NATIONAL ROOFING CONTRACTORS ASSOCIATION
2.169 NSF -- NSF INTERNATIONAL (THE PUBLIC HEALTH AND SAFETY ORGANIZATION)
2.170 NSPI -- NATIONAL SPA AND POOL INSTITUTE
2.171 NSSA - National Storm Shelter Association
2.172 NTMA -- NATIONAL TERRAZZO AND MOSAIC ASSOCIATION, INC., THE
2.173 NTMA -- NATIONAL TILE AND MARBLE ASSOCIATION
2.174 NWFA -- NATIONAL WOOD FLOORING ASSOCIATION
2.175 PCA -- PORTLAND CEMENT ASSOCIATION
2.176 PCI -- PRECAST/PRESTRESSED CONCRETE INSTITUTE
2.177 PDI -- PLUMBING AND DRAINAGE INSTITUTE
2.178 RCSC -- RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS
2.179 RIS -- REDWOOD INSPECTION SERVICE
2.180 RFCI -- RESILIENT FLOOR COVERING INSTITUTE
2.181 SAE -- SAE INTERNATIONAL
2.182 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
2.183 SCS - SCIENTIFIC CERTIFICATION SYSTEMS
2.184 SDI -- STEEL DECK INSTITUTE
2.185 SDI -- STEEL DOOR INSTITUTE
2.186 SEFA -- SCIENTIFIC EQUIPMENT AND FURNITURE ASSOCIATION
2.187 SIGMA -- SEALED INSULATING GLASS MANUFACTURERS ASSOCIATION (SEE IGMA)
2.188 SJI -- STEEL JOIST INSTITUTE
2.189 SMA -- SCREEN MANUFACTURERS ASSOCIATION
2.190 SMACNA -- SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
2.191 SPIB -- SOUTHERN PINE INSPECTION BUREAU, INC.
2.192 SPRI -- SINGLE PLY ROOFING INDUSTRY
2.193 SRI -- STEEL RECYCLING INSTITUTE
2.194 SSPC -- SOCIETY FOR PROTECTIVE COATINGS
A. SSPC-SP 2 - Hand Tool Cleaning 2018.
2.195 STI -- STEEL TANK INSTITUTE
2.196 SWI -- STEEL WINDOW INSTITUTE
2.197 SWRI -- SEALANT, WATERPROOFING AND RESTORATION INSTITUTE
2.198 TCNA -- TILE COUNCIL OF NORTH AMERICA, INC.
2.199 TIA -- TELECOMMUNICATIONS INDUSTRY ASSOCIATION
2.200 TPI -- TRUSS PLATE INSTITUTE
2.201 TPI -- TURFGRASS PRODUCERS INTERNATIONAL
2.202 UL -- UNDERWRITERS LABORATORIES INC.
2.203 USGBC -- U.S. GREEN BUILDING COUNCIL
2.204 WCLIB -- WEST COAST LUMBER INSPECTION BUREAU
2.205 WCMA -- WINDOW COVERING MANUFACTURERS ASSOCIATION
A. WCMA A100.1 - Safety of Window Covering Products 2018.
2.206 WDMA -- WINDOW AND DOOR MANUFACTURERS ASSOCIATION (formerly NWWDA)
2.207 WI -- WOODWORK INSTITUTE
2.208 WMMPA -- WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION
2.209 WWPA -- WESTERN WOOD PRODUCTS ASSOCIATION

PART 3 UNITED STATES GOVERNMENT AND RELATED AGENCIES DOCUMENTS

3.1 CFR -- CODE OF FEDERAL REGULATIONS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

3.2 ATBCB -- US ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD (THE ACCESS BOARD)

A. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.

3.3 CPSC -- CONSUMER PRODUCTS SAFETY COMMISSION

3.4 EPA -- ENVIRONMENTAL PROTECTION AGENCY

3.5 FAA -- FEDERAL AVIATION ADMINISTRATION

3.6 FEMA -- U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY

3.7 FHWA -- FEDERAL HIGHWAY ADMINISTRATION

3.8 FS -- FEDERAL SPECIFICATIONS AND STANDARDS (General Services Administration)

3.9 GSA -- U.S. GENERAL SERVICES ADMINISTRATION

3.10 HHS -- U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, CENTERS FOR DISEASE CONTROL AND PREVENTION

3.11 MIL -- MILITARY SPECIFICATIONS AND STANDARDS

3.12 NIJ -- NATIONAL INSTITUTE OF JUSTICE (DEPT. OF JUSTICE)

3.13 NSA -- NATIONAL SECURITY AGENCY

3.14 PS -- PRODUCT STANDARDS

3.15 USAB -- UNITED STATES ACCESS BOARD

A. ABA Standards - ABA Accessibility Standards 2004 (Amended 2015).

3.16 USGS -- UNITED STATES GEOLOGICAL SURVEY

END OF SECTION

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary utilities.
B. Temporary sanitary facilities.
C. Temporary Controls: Barriers, enclosures, and fencing.
D. Security requirements.
E. Vehicular access and parking.
F. Waste removal facilities and services.
G. Project identification sign.
H. Field offices.

1.2 TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

1.3 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.

1.4 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide protection for plants designated to remain. Replace damaged plants.
C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.5 FENCING

A. Construction: Commercial grade chain link fence.
B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.6 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.7 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.
C. Provide and maintain access to fire hydrants, free of obstructions.
D. Provide means of removing mud from vehicle wheels before entering streets.
E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.8 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
B. Provide containers with lids. Remove trash from site periodically.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.9 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.
B. Erect on site at location indicated.
C. No other signs are allowed without Owner permission except those required by law.

1.10 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General product requirements.
B. Re-use of existing products.
C. Transportation, handling, storage and protection.
D. Product option requirements.
E. Substitution limitations.
F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
B. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.3 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
    1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.1 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.2 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

2.3 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.4 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.2 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 017000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Pre-installation meetings.
D. Cutting and patching.
E. Cleaning and protection.
F. Starting of systems and equipment.
G. Demonstration and instruction of Owner personnel.
H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
I. General requirements for maintenance service.

1.2 RELATED REQUIREMENTS

A. Section 011000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
B. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
C. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
D. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
E. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
F. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
G. Section 024100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
    1. Structural integrity of any element of Project.
    2. Integrity of weather exposed or moisture resistant element.
    3. Efficiency, maintenance, or safety of any operational element.
    4. Visual qualities of sight exposed elements.
    5. Work of Owner or separate Contractor.
    6. Include in request:
        a. Identification of Project.
        b. Location and description of affected work.
        c. Necessity for cutting or alteration.
        d. Description of proposed work and products to be used.
        e. Effect on work of Owner or separate Contractor.
        f. Written permission of affected separate Contractor.
        g. Date and time work will be executed.
C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.4 PROJECT CONDITIONS

A. Use of explosives is not permitted.
B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.5 COORDINATION

A. See Section 011000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect five days in advance of meeting date.

D. Prepare agenda and preside at meeting:

1. Review conditions of examination, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, Architect, and those affected by decisions made.

3.4 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.

3. Building foundation, column locations, ground floor elevations.
4. Controlling lines and levels required for mechanical and electrical trades.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
2. Remove items indicated on drawings.
3. Relocate items indicated on drawings.
4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.

2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.7 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:

1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to specified condition. Restore to original condition if condition is not specified.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

J. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.8 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.9 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Prohibit traffic from landscaped areas.

H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and Owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 - Demonstration and Training.

B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning after Substantial Completion but before making final application for payment.

1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Replace filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
C. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
D. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
F. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
G. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Methods of trash/waste disposal that are not acceptable are:

1. Burning on the project site.
2. Burying on the project site.
3. Dumping or burying on other property, public or private.
4. Other illegal dumping or burying.

E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosively, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosively, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 3 EXECUTION

2.1 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

END OF SECTION

SECTION 017800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Project Record Documents.
B. Operation and Maintenance Data.
C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

A. Section 007200 - General Conditions and 007300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
B. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
C. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.
D. Individual Product Sections: Specific requirements for operation and maintenance data.
E. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

A. Project Record Documents: Submit documents to Architect a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion.
B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.
B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Store record documents separate from documents used for construction.
D. Record information concurrent with construction progress.
E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.2 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Additional information as specified in individual product specification sections.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:

1. Description of unit or system, and component parts.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Include test and balancing reports.

L. Additional Requirements: As specified in individual product specification sections.

3.5 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:

1. Project Directory.
2. Table of Contents, of all volumes, and of this volume.
3. Operation and Maintenance Data: Arranged by system, then by product category.
    a. Source data.
    b. Product data, shop drawings, and other submittals.
    c. Operation and maintenance data.
    d. Field quality control data.
    e. Photocopies of warranties and bonds.

3.6 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:

1. All software-operated systems.
2. HVAC systems and equipment.
3. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:

1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
2. Items specified in individual product Sections.

1.2 RELATED REQUIREMENTS

A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.

1. Submit to Architect for transmittal to Owner.
2. Submit not less than two weeks prior to start of training.
3. Revise and resubmit until acceptable.
4. Provide an overall schedule showing all training sessions.
5. Include at least the following for each training session:
   a. Identification, date, time, and duration.
   b. Description of products and/or systems to be covered.
   c. Name of firm and person conducting training; include qualifications.
   d. Intended audience, such as job description.
   e. Objectives of training and suggested methods of ensuring adequate training.
   f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
   g. Media to be used, such a slides, hand-outs, etc.
   h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Reports:

1. Identification of each training session, date, time, and duration.
2. Sign-in sheet showing names and job titles of attendees.
3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstration may be combined with Owner personnel training if applicable.

C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks after Substantial Completion.

3.2 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Owner will provide classroom and seating at no cost to Contractor.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.
2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
3. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:

1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 41 13
SITE DEMOLITION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: removal of existing buildings, equipment pads, foundations, paving, curb and gutter, underground tanks, pipes and utilities, fences, and other site items as required by the project drawings.

1.2 SUBMITTALS

A. Obtain necessary permits required for demolition and submit copies to the Owner before beginning site demolition work.

1.3 PROTECTION

A. Protection of Existing Work: Before beginning cutting or other site demolition work, carefully survey the existing work and examine the project drawings and specifications to determine the extent of the work. Take necessary precautions to ensure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damage to work at no additional cost to the Owner. Carefully coordinate the work of this section with other work and construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded. Increase structural support or add new supports, as required as a result of cutting, removal, or demolition of work performed.

B. Benchmarks, Property Markers, and Iron Pins: The Contractor shall maintain all benchmarks, monuments, property markers, iron pins and other reference points during site clearing operations. In the event that any of the above mentioned are disturbed or destroyed during any construction activities the Contractor shall replace them, as directed by the Owner, at the Contractor's expense.

C. Existing Utilities:

1. Follow rules and regulations of the authorities having jurisdiction for the respective utilities in execution of the work under this section.
2. Active Utilities Shown on Project Drawings: Protect from damage and remove or relocate only as indicated or specified. Take special precautions not to damage utility lines, manholes, or other structures. Correct any damage to utilities or structures to original or better condition at no additional cost to the Owner.
3. Active Utilities Not Shown on Project Drawings: When any functioning underground utilities are uncovered during the work which are not shown on the project drawings, promptly notify the Owner in writing. Protect or relocate in accordance with written instructions of the Owner. The Contractor shall exercise caution during all phases of the work, as all utilities may not be shown on the Project Drawings. A utilities' omission

from the Project Drawings will not relieve the Contractor of their responsibility to correct any damage to said utility at no additional cost to the Owner.

4. Inactive and Abandoned Utilities: Remove, plug, or cap in the absence of specific requirements. Plug or cap utility lines at least five feet outside of new building walls or as required by local regulations.

D. Adjacent Properties: Protect adjacent properties during site demolition operations. Site demolition shall be limited to Owner's property. The Contractor shall also protect existing structures on adjacent properties; including by not limited to fences, utility lines, manholes, catch basins, valve boxes, poles, guys and other appurtenances. Damage done to structures on adjacent properties shall be the Contractor's responsibility to repair, at no additional cost to the Owner.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 DEMOLITION

A. Structures: Demolish existing structures by breaking these materials into smaller pieces for transport. The use of explosives is not permitted.

B. Utilities: Remove or abandon in place existing utilities as indicated on the project drawings. Disconnect utility services, with related meters and equipment, employing appropriate utility company. When utility lines are encountered that are not indicated on the project drawing, notify the Owner.

C. Sidewalks, driveways, curb and gutter, drainage structures and similar obstructions permitted to be removed shall be cut in straight lines or removed to the nearest construction joint if located within five feet of the edge of the excavation. In no case shall the joint or line of cut be less than one foot outside the edge of excavation.

3.2 RELOCATION AND RETURN OF MATEIRAL OR EQUIPMENT

A. Carefully dismantle, in manner to avoid damage, all materials and equipment specified or indicated to be relocated or returned to the Owner.

B. Store materials and equipment to be reused in a manner to avoid corrosion, staining, breakage, or damage.

C. Material or equipment specified or indicated to be relocated or returned to the Owner and damage due to Contractor's negligence shall be repaired or replaced as directed by Owner.

3.3 DISPOSITION OF MATERIALS

A. Dispose of demolished materials off of the project site unless otherwise notified by the Owner. Transport materials in a manner that will prevent spillage on streets and adjacent

areas. Dispose of materials in a manner acceptable to the regulatory agency having jurisdiction.

3.4 PROTECTION OF EXISTING TREES

A. Protect trees to remain in the manner described in Section 31 10 00 Site Clearing.

B. Provide tree protection measures prior to beginning of demolition and maintain throughout the work period.

3.5 BACKFILLING AND COMPACTION

A. Backfill holes and depressions resulting from site demolition in the manner described in Section 31 23 00 Excavation and Fill.

END OF SECTION 024113

SECTION 030516 - UNDERSLAB VAPOR BARRIER - STEGO

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.3 REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products.

C. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Underslab Vapor Barrier:

1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
2. Thickness: 15 mils.
3. Products: Subject to compliance with requirements, provide one of the following:
    a. Grace Construction Products, W.R. Grace & Co.; Perminator 15 mil
    b. Stego Industries LLC; Stego Wrap Vapor Barrier 15 mil
    c. Substitutions: See Section 016000 - Product Requirements.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.2 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.

B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

C. Lap joints minimum 6 inches.

D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

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. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.

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.

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 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. 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. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

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.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.6 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. 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.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete 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 subcontractor.
e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, [vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 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 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. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. 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.

H. 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 (25 mm) to the plane of exposed concrete surface.
    2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
    3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

D. Deformed-Steel Wire: ASTM A 496/A 496M.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), 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. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 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 I/II. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal, typical. 3/8” nominal at elevated slabs on metal deck.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

2.5 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.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 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. (305 g/sq. m) 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.

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.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. 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 I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) 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 (6.4 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 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.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. 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.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Refer to drawings.

B. Foundation Walls: Refer to drawings.

C. Slabs-on-Grade: Refer to drawings.

D. Suspended Slabs: Refer to drawings.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 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. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), 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 mixer capacity of 1 cu. yd. (0.76 cu. m) 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 mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

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. Construct forms tight enough to prevent loss of concrete mortar.

D. 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.

E. 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.

F. 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.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. 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. 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 (10 deg C) 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.

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 RETARDERS

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 (150 mm) and seal with manufacturer's recommended tape.

3.5 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/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.

3.6 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 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. Space vertical joints in walls at 2 times the wall height. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. 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, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints for Exterior Slabs Only: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2

mm). 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- (3.2-mm-) 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 (13 mm) or more than 1 inch (25 mm) 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 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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

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 (150 mm) 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 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.

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 (4.4 deg C) 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 (32 deg C) 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.

3.8 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.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, 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 restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

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 indicated, exposed to view, or to be covered with flooring.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed **1/8 inch (3.2 mm)**.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or exposed to weather. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. 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.

3.10 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. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 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 (1 kg/sq. m 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 (300-mm) 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 (300 mm), 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 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.

3.12 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. 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.

C. 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.

3.13 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 (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 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 (1.18-mm) 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 to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 (0.25 mm) 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) 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.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector 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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) 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 (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. 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.
7. 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.

8. 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.

9. 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.
10. 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 (3.4 MPa).
11. 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.
12. 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.
13. 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.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 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 033511 - CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface treatments for concrete floors and slabs.
   1. Sealed Concrete

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
B. Section 033000 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.3 REFERENCES

A. ASTM 3363-05 Standard Test Method for Film Hardness by Pencil Test.
B. ASTM D2047 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method (Slip Coefficient).
C. ASTM D523 tandard test for Specular Gloss – Gloss Meter Reflectivity.
D. ASTM E 430 Standard Method for Measurement of Gloss of High Gloss surfaces by Abridged Goniophotometry.
E. ASTM E1155 Standard Test for Determining FF Floor Flatness and FL Floor Levelness Numbers.
F. ACI 302.1R-89 American Concrete Institute Guide for Concrete Floor and Slab Construction.
G. CPAA: Concrete Polishing Association of America.
H. American Society of Concrete Contractors, Concrete Polishing Council.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
C. Maintenance Data: Provide data on maintenance and renewal of applied finishes. These instructions should contain precautions against cleaning products and methods that may be detrimental to finishes and performance.
D. Samples for Initial Selection: For each type of product requiring color selection.

1.6 QUALITY ASSURANCE

A. Protection:
   1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from concrete surfaces. Prevention is therefore essential.
      a. All hydraulic powered equipment must be diapered to avoid staining the concrete.
      b. No trade will park vehicles on the inside slab. If parking on the inside slab is necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
      c. No pipe fitting machine will be used on the inside slab floor.
      d. Steel will not be placed on interior slab to avoid rust staining.
      e. Acids and acidic detergents will not come into contact with slab.
      f. All trades informed that the slab must be protected at all times.
      g. A janitorial-grade acrylic floor finish shall be applied to protect the slab from stains.

1.7 MOCK-UP

A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
B. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.9 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F minimum.

D. Concrete must be cured a minimum of 28 days.

E. Comply with manufacturer's written instructions of substrate temperature, moisture content, ambient temperature, humidity, ventilation and other conditions affecting process.

1. Alkalinity
    a. Test Method: Measure pH according to method indicated in ASTM F710
    b. Acceptable results: 8- 13.
2. Moisture Vapor Transmission Rate:
    a. Test Method: Perform anhydrous calcium chloride test according to ASTM F 1869.
    b. Acceptable results: Not more than 5 pounds per 1000 square feet in 24 hours.
3. Relative Humidity:
    a. Test Method: Perform relative humidity test using in-situ probes according to ASTM F 2170.
    b. Acceptable results: Not more than 75 percent.

F. Inspect the existing substrate and document unsatisfactory conditions in writing. Verify that surfaces and site conditions are ready to receive work. Correct unacceptable conditions prior to installation of system. Commencement of work constitutes acceptance of substrate conditions.

G. Close areas to traffic during and after application for a time period recommended by the manufacturer.

PART 2 PRODUCTS

2.1 DENSIFIERS AND HARDENERS

A. Pre- Densifier floor cleaner: As recommended by densifier manufacturer.

B. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.

2.2 COATINGS

A. Stain Protector: Concrete chemical stain protector specifically for concrete surface treatment which reacts chemically to the concrete surface maintaining a clear, dense, durable, hard, abrasion and chemical resistant surface. Product shall be a solution that is less than 40 VOC.

B. Colored Coating: Pigmented coating recommended by manufacturer for finishing concrete floors and slabs.

1. Gloss: Matte.
2. Color(s): As selected by Architect from manufacturer's standard range.

2.3 EQUIPMENT

A. Sprayer: Manufacturer approved high volume, low pressure sprayer and sprayer tip.

B. Scrubber Machine used for cleaning operations shall have a head pressure of 150 lbs. or as required to produce the specified results.

C. Field Grinding and Polishing Equipment: A multi-head, counter rotating, walk-behind or ride-on machine, of various size and weights, with diamond tooling affixed to the head for the purpose of grinding concrete. Excludes janitorial maintenance equipment.

1. Use equipment capable of removing generated dust for dry grinding, honing or polishing.
2. Use equipment capable of slurry extraction and containment for wet grinding, honing or polishing

2.4 ACCESSORIES

A. Oil remediation system
B. pH compatible detergent
C. Repair material: A product that is designed to repair cracks and surface imperfections. The specified bonding materials shall have sufficient bonding to adhere after polishing process and to have abrasion resistance equal to or greater than adjacent substrate.
D. Grout Material: A thin mortar used for filling voids such as a rapid set structural repair polymer or other material as recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.
C. Examine substrate for conditions affecting polishing process. Correct conditions detrimental to process.
D. Verify that concrete floor flatness rating is at least 40. Notify the contractor if floor flatness rating not achieved. Do not proceed with installation unitl concrete floor flatness rating is achieved.
E. Verify that concrete floor levelness rating is at least 30. Notify the contractor if floor levelness rating not achieved. Do not proceed with installation unitl concrete floor levelness rating is achieved.

3.2 GENERAL

A. Apply materials in accordance with manufacturer's instructions.
B. Application is to take place at least 10 days prior to placement of furniture, fixtures and/or equipment, thus providing a complete, uninhibited concrete slab for application.
C. Fill joints and saw cuts, repair spawled areas.
D. Shave and level filled areas.
E. Start any of the floor finish applications in presence of manufacturer’s technical representative.

3.3 CLEANING

A. Coordinate with joint filling operations. DO NOT perform wet cleaning within 72 hours prior to joint filling or per joint filler manufacturer’s recommendations.
B. Do not use stain or scuff removing agents on finished floor surface.
C. Use non-oil based sweeping compound to control airborne dust.
D. Treat oil spots with oil remediation system.
E. Scrub floor with scrubber machine and appropriate brushes or pads and pH compatible detergent.

3.4 COATING APPLICATION

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural precast concrete accessories.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing perimeter and intermediate joints.

1.3 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary 2014 (Errata 2018).

B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2012.

C. ASTM C150/C150M - Standard Specification for Portland Cement 2020.

D. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

E. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete 2019.

F. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars 2018a.

G. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures 2020.

H. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products 2013.

I. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete 2017.

J. PCI MNL-122 - Architectural Precast Concrete 2007.

K. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete 1988.

L. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction 2000.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.

C. Shop Drawings: Indicate layout, unit locations, configuration,reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials.

D. Samples: Submit __4__by___4_ inch in size, illustrating surface finish, color and texture.

E. Maintenance Data: Indicate surface cleaning instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handling: Lift and support precast units only from support points.

B. Protect units to prevent staining, chipping, or spalling of concrete.

PART 2 PRODUCTS

2.1 PRECAST UNITS, GENERAL

A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.

1. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
2. Calculate structural properties of units in accordance with ACI 318.
3. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
4. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

B. Finish Type A: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

2.2 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.

B. Other Cementitious Materials:

1. Fly Ash or Natural Pozzolans: Comply with ASTM C618.
2. Ground Granulated Blast Furnace Slag: ASTM C989/C989M.
3. Silica Fume: Comply with ASTM C1240.

C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

D. Air Entrainment Admixture: ASTM C260/C260M.

E. Grout:

1. Non-shrink, non-metallic, minimum 10,000 psi, 28 day strength.

2.3 FABRICATION

A. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.

B. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.

C. Maintain consistent quality during manufacture.

D. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

E. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.

F. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

G. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

2.4 FABRICATION TOLERANCES

A. Comply with PCI MNL-117 and PCI MNL-135, except as specifically amended below.

1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 in.
2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
3. Maximum Variation from Thickness: Plus or minus 1/8 in.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.2 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect units level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

3.3 CLEANING

A. Clean surfaces of precast concrete units exposed to view per manufacturer recommendations.

3.4 PROTECTION

A. Protect installed units from subsequent construction operations.

END OF SECTION

SECTION 040511 - MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar for masonry.

1.2 REFERENCE STANDARDS

A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes 2018.
B. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
D. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
F. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
G. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.
H. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry 1995 (Reapproved 2013).

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.5 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT APPLICATIONS

A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.
B. Mortar Mix Designs: ASTM C270, Property Specification.
    1. Exterior Repointing Mortar: Type N with maximum 2 percent ammonium stearate or calcium stearate per cement weight.

2.2 MATERIALS

A. Packaged Dry Material for Mortar for Repointing: Premixed Portland cement, graded sand, and chemical admixtures complying with ASTM C91/C91M with the addition of water only.
    1. Color: Match Existing.
B. Portland Cement: ASTM C150/C150M.
    1. Type: Type I - Normal; ASTM C150/C150M.
    2. Color: Standard gray.
    3. Manufacturers:
        a. Solomon Colors; Solomon Colors Concentrated A, H, and X Series: www.solomoncolors.com/#sle.
C. Masonry Cement: ASTM C91/C91M.
    1. Type: Type N; ASTM C91/C91M.
    2. Colored Mortar: Premixed cement as required to match Architect's color sample.
    3. Manufacturers:

a. Solomon Colors; Solomon Colors Concentrated A, H, and X Series: www.solomoncolors.com/#sle.

D. Hydrated Lime: ASTM C207, Type S.
E. Quicklime: ASTM C5, non-hydraulic type.
F. Mortar Aggregate: ASTM C144.
G. Water: Clean and potable.

2.3 MORTAR MIXING

A. Ready Mixed Mortar: ASTM C1142, Type equivalent to that specified according to ASTM C270.
B. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
C. Maintain sand uniformly damp immediately before the mixing process.
D. Do not use anti-freeze compounds to lower the freezing point of mortar.
E. If water is lost by evaporation, re-temper only within two hours of mixing.

2.4 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 014000 - Quality Requirements.
B. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install mortar to requirements of section(s) in which masonry is specified.

3.2 FIELD QUALITY CONTROL

A. An independent testing agency will perform field tests, in accordance with provisions of Section 014000 - Quality Requirements.
B. Test and evaluate mortar in accordance with ASTM C780 procedures.

END OF SECTION

SECTION 042001 - MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clay facing brick.
B. Mortar.
C. Reinforcement and anchorage.
D. Flashings.
E. Installation of lintels.
F. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 076200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
B. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2017.
D. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
F. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
H. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2019.
I. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
J. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
K. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.
L. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting masonry veneer work.

1.5 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and anchors.
B. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.
C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
D. Closeout:
    1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum five years ofdocumented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at leastfive years ofdocumented experience.

1.7 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized 6 feet long by 6 feet high; include mortar and accessories and structural backup in mock-up.
B. Locate where directed.
C. Mock-up may not remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.9 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.1 BRICK UNITS

A. Basis of Design Product: Subject to compliance with requirements, provide or Architect approved equal.
   1. General Shale Brick: www.generalshale.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Facing Brick: ASTM C216, Type FBX, Grade SW.
   1. Color and Texture: to be selected from manufacturer's full range including custom colors.
   2. Actual Size: 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
   3. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
   4. Compressive Strength: Individual Brick: 2200 psi, measured in accordance with ASTM C67.

2.2 MORTAR MATERIALS

A. Masonry Cement: ASTM C91/C91M Type N.
   1. Colored Mortar: Premixed cement as required for Architect to select from manufacturer;s full range.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

A. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
   3. Vertical adjustment: Not less than 3-1/2 inches.
   4. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc ; DW-10-X. or a comparable product by one of the following:
      a. Wire-Bond.
      b. RodenHouse Fastening Systems
      c. Substitutions: See Section 016000 - Product Requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc ; HB-213 or a comparable product by one of the following:
   1. [Wire-Bond].
   2. RodenHouse Fastening Systems
   3. Substitutions: See Section016000-Product Requirements.

C. Screw-Attached, Masonry-Veneer Anchors: Wing nut ascrew nchor ties with washers seals
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Hohmann & Barnard, Inc ; Thermal 2-Seal Wing Nut Anchor. or a comparable product by one of the

following:
a. Wire-Bond.
b. RodenHouse Fastening Systems
c. Substitutions: See Section 016000 - Product Requirements.
2. Coordinate anchor length with continuous insulation thickness. See drawings.
3. Coordinate hook size with width masonry cavity. See drawings.

2.4 FLASHINGS

A. Metal Flashing Materials: Stainless Steel, as specified in Section 076200.
B. Factory-Fabricated Flashing Corners and Ends: Thermoplastic polyolefin (TPO).
1. Manufacturers:
a. Mortar Net Solutions; CompleteFlash: www.mortarnet.com/#sle.
C. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane, or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
D. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.5 ACCESSORIES

A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.
B. Joint Filler: Closed cell polyethylene; oversized 50 percent to joint width; self expanding; in maximum lengths available.
C. Weeps:
1. Type: Polyester mesh.
2. Color(s): As selected by Architect from manufacturer's full range.
3. Manufacturers:
a. Mortar Net Solutions; WeepVent: www.mortarnet.com/#sle.
D. Cavity Vents:
1. Type: Extruded propylene with honeycomb design.
2. Color(s): As selected by Architect from manufacturer's full range.
3. Manufacturers:
a. Mortar Net Solutions; CellVent: www.mortarnet.com/#sle.
E. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Panels installed at flashing locations.
a. Manufacturers:
1) Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
F. Multicomponent Cavity Wall Drainage System: Combination mortar diverter, flashing and weep system.
1. Membrane Type: Thermoplastic vinyl.
2. Drip Edge: Stainless steel.
3. Termination Bar: Polyvinyl chloride (PVC)
4. System Unit Length: 5 feet, 6 inches.
5. Manufacturers:
a. Mortar Net Solutions; TotalFlash Panel: www.mortarnet.com/#sle.
G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MORTAR MIXING

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
1. Masonry below grade and in contact with earth; Type S.

2. Exterior, non-loadbearing masonry; Type N.

B. Colored Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color as selected by Architect.

C. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:

1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave.

3.3 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar as work progresses.

E. Interlock intersections and external corners, except for units laid in stack bond.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible joint filler.

3.4 WEEPS/CAVITY VENTS

A. Install weeps in veneer walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and any other areas where cavity is interrupted.

B. Install cavity vents in veneer walls at 24 inches on center horizontally below shelf angles and lintels and at top of walls.

3.5 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.6 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16" inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.7 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 1 inch, minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
   2. Anchor vertical leg of flashing into backing with a termination bar and sealant.
   3. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Install flashing in accordance with manufacturer's instructions.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

E. Support flexible flashings across gaps and openings.

F. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.8 LINTELS

A. Install loose steel lintels over openings.

B. Maintain minimum 8" inch bearing on each side of opening. Verify with Structural drawings.

3.9 CONTROL AND EXPANSION JOINTS

A. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

B. Size control joints as indicated on drawings; if not indicated, 3/8" inch wide and deep.

C. Form expansion joint as detailed on drawings.

3.10 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.13 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

C. Samples: For each type and color of the following:

1. Exposed CMUs.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 48 inches (1200 mm) 48 inches high. Sample panel may remain as part of the final work.

1.6 FIELD 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. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, 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. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

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.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (14.8 MPa)
2. Density Classification: Normal weight.
3. Finish - Smooth

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, 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. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Aggregate for Mortar: ASTM C 144.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.4 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
1. Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
4. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
5. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

2.5 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
2. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 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 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.02 mm**)**.

4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.0 mm) thick.

C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

E. 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.

2.6 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 urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 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 felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.7 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 or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

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, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.

D. 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 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi (21 MPa).

3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

3.2 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 (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) 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 (6 mm in 3 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).

3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.3 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 running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. 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.

F. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) 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. Provide continuity at corners by using prefabricated L-shaped units.

E. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

F. 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 lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

G. 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.

3.6 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 that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

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 TMS 602/ACI 530.1/ASCE 6 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 48 inches.

3.7 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. 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.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

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. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at seven days and at 28 days.

3.8 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.9 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. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 042616 - ADHERED MASONRY VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Thin Brick.
B. Mortar.
C. Adhesives.
D. Accessories.

1.2 REFERENCE STANDARDS

A. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2013 (Revised).
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
D. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
E. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
F. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
H. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
I. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring 2003 (Reapproved 2018).
J. ASTM C847 - Standard Specification for Metal Lath 2018.
K. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
L. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster 2020a.
M. ASTM C1088 - Standard Specification for Thin Veneer Brick Units Made From Clay or Shale 2020.
N. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
O. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.
P. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.
Q. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting adhered masonry veneer work.

1.4 SUBMITTALS

A. Product Data: Provide data for thin brick units, mortar, grout, and adhesive.
B. Samples: Submit four samples of thin brick units to illustrate color, texture, and extremes of color range.

1.5 MOCK-UP

A. Construct a mock-up panel sized 4 feet long by 4 feet high; include mortar, grout, adhesives, accessories, and substrate in mock-up.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
B. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.7 FIELD CONDITIONS

A. Do not install adhesives in an unventilated environment.
B. Maintain materials and surrounding air temperature to minimum 40 F prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.1 THIN BRICK

A. Manufacturers:
   1. General Shale Brick: www.generalshale.com/#sle.

B. Thin Brick: ASTM C1088.
   1. Type: TBS.
   2. Thickness: 5/8 inch.
   3. Tolerances: 3/32 inch.
   4. Color, Texture, Range, Special Shapes: As selected by Architect from manufacturer's standard range of colors, textures and blends.
   5. Protective Coating: Wax.

2.2 ADHESIVE MATERIALS

A. Thin-Set Mortar: ANSI A118.4, polymer-modified; freeze-thaw stable.

B. Epoxy Adhesive: ANSI A118.3, <> , thinset bond type.

2.3 MORTAR MATERIALS

A. Masonry Cement: ASTM C91/C91M Type N.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.

E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As indicated on drawings.

F. Water: Clean and potable.

G. Accelerating Admixture: Nonchloride type for use in cold weather.

H. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

2.4 MORTAR MIXES

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
   1. Masonry below grade and in contact with earth: Type S.
   2. Exterior, non-loadbearing masonry: Type N.
   3. Interior, non-loadbearing masonry: Type O.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

2.5 FLASHINGS

A. Pre-Coated Galvanized Steel: ASTM A653/A653M, with G90/Z275 coating, 24 gage, 0.0239 inch total thickness, shop precoated with fluoropolymer coating in color matching masonry.

B. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane, or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.

2.6 LATH

A. Diamond Mesh Metal Lath: ASTM C847, galvanized; [_____].
   1. Weight: 2.5 lb/sq yd, minimum.

2.7 ACCESSORIES

A. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

B. Air and Water Barrier: Single component, fluid applied, vapor permeable; waterproofing, crack isolation, and air barrier membrane.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive thin brick veneer.
B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for installation of thin brick veneer.

3.2 INSTALLATION

A. Interior Applications: Comply with TCNA (HB) Method W211, W221, W222, W223, W231, W241, W242, W243, W244C, W244F, W245, W246, or W247.
B. Exterior Applications: Comply with TCNA (HB) Method W201, W202, or W244E.
C. Install interior lath and furring in accordance with ASTM C841.
D. Install lath and furring for Portland cement plaster in accordance with ASTM C1063.

3.3 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

3.4 PLACING AND BONDING

A. Remove excess mortar as work progresses.
B. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove and replace.
C. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.5 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
    1. Extend flashings full width at such interruptions at least 6 inches, minimum, to form watertight pan.
    2. Remove or cover protrusions or sharp edges that could puncture flashings.
B. Extend metal flashings through exterior face of masonry and turn down to form drip.
C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.6 CONTROL AND EXPANSION JOINTS

A. Form joints as detailed on drawings.

3.7 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

3.8 CUTTING AND FITTING

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

3.9 CLEANING

A. Remove excess mortar and mortar smears as work progresses.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Use non-metallic tools in cleaning operations.

3.10 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel and grout.

B. Related Sections:
   1. Division 05 Section "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed 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."

1.3 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using details indicated.
   2. Use ASD; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
   1. Show fabrication of structural-steel components: Submit for review and approval shop drawings showing complete details and schedules for fabrication and assembly of structural steel members.
   2. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Holes, flange cuts, slots and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
   3. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.

C. Qualification Data: For qualified fabricator.

D. Welding certificates.

E. Mill test reports for structural steel, including chemical and physical properties.

F. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: The structural steel fabricator must have minimum of 5 years' experience in the successful fabrication of structural steel similar to this project. Provide documentation of 5 projects of similar size and scope successfully completed in the past 5 years.

B. Installer Qualifications: A qualified installer that has a minimum of 5 years' experience and has experience on similar size projects. Provide documentation of 5 projects of similar size and scope successfully completed in the past 5 years.

C. Detailer Qualifications: The structural steel detailer shall have not less than 5 years' experience in the successful detailing of structural steel similar to this project including experience in selecting or completing structural steel connection details using information found in tables in the AISC "Steel Construction Manual.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360. "Specification for Structural Steel Buildings".
   3. RCSC's "Specification for Structural Joints using High-Strength Bolts".
   4. ANSI/AISC 358, "Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications
   5. ANSI/AWS D1.1 "Structural Welding Code -Steel.

F. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL

A. All structural or miscellaneous support steel exposed to the exterior shall be non-galvanized ferrous metal with a High Performance Coating (Work of Section 099600), except as follows:
   1. Steel bollards shall be galvanized (or coated with a High Performance Coating).

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).

F. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

G. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

H. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
   1. Finish: Black except where indicated to be galvanized.

I. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

C. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   1. Configuration: Straight.
   2. Finish: Plain.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Finish: Plain.

E. Threaded Rods: ASTM A 36/A 36M.
   1. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.

2.3 PRIMER

A. Primer: Fabricator to shop prime with standard primer. Primer to be non-asphaltic rust inhibitor, lead and chromate free.

2.4 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.

2.5 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.

2.6 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.

2.7 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. 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 2, "Hand 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.

2.8 SOURCE QUALITY CONTROL

A. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. 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.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Pretension 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. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 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: 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. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 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 tested and 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.

END OF SECTION 051200

SECTION 05 3100 – 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. Roof deck.
   2. Noncomposite form 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 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.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Canam United States; Canam Group Inc.
   2. Nucor Corp.; Vulcraft Group.
   3. Or equal.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) zinc coating.
   2. Deck Profile: As indicated on structural drawings.
   3. Profile Depth: As indicated on structural drawings.
   4. Design Uncoated-Steel Thickness: As indicated.
   5. Span Condition: Triple span or more.
   6. Side Laps: Overlapped.

2.3 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. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum.
   2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 minimum, G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
   3. Color: Manufacturer's standard.
   4. Profile Depth: As indicated on plans.
   5. Design Uncoated-Steel Thickness: As indicated on plans.

6. Span Condition: Triple span or more.
7. Side Laps: Overlapped.

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 (4.8-mm) 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 (230 MPa), not less than 0.0359-inch (0.91-mm) 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 (230 MPa), of same material and finish as deck, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A 780.

PART 2 - EXECUTION

2.1 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.

2.2 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.

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.

2.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by welding or mechanically fastening, and as follows:
   1. As indicated on drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (914 mm), or as indicated on the Drawings, and as follows:
   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

2.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting as follows:

1. As indicated on drawings.

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 18 inches and as follows:

1. As indicated on drawings.

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.

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.

2.5 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.

2.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. 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

SECTION 061010 - NON-STRUCTURAL ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Miscellaneous framing and sheathing.
B. Communications and electrical room mounting boards.
C. Concealed wood blocking, nailers, and supports.
D. Miscellaneous wood nailers, furring, and grounds.
E. Wall sheathing with factory applied water-resistive and air barrier sheet.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.
F. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies 2018.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
I. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
J. ICC-ES AC310 - Acceptance Criteria for Water-resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-Resistive Barriers 2008, with Editorial Revision (2015).
K. PS 1 - Structural Plywood 2009 (Revised 2019).
L. PS 2 - Performance Standard for Wood-Based Structural-Use Panels 2010.
M. PS 20 - American Softwood Lumber Standard 2020.

1.4 SUBMITTALS

A. Product Data: Provide technical data on non-structural wall sheathing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation. Do not stack wood products in contact with ground.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20.
    1. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
    2. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.

2.3 CONSTRUCTION PANELS

A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.

1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Edges: Square.

B. Wall Sheathing: Glass mat faced gypsum with integral water-resistive and air barrier, ASTM C1177/C1177M, 5/8 inch thick.

1. Edges: Square.
2. Water Vapor Permeance: 6.78 perms, minimum, when tested in accordance with ASTM E96/E96M.
3. Air Permeance, Sheathing: 0.004 cfm per square foot, maximum, when tested in accordance with ASTM E2178.
4. Air Permeance, Assembly: 0.04 cfm per square foot, maximum, when tested in accordance with ASTM E2357.
5. Fluid-Applied Flashing: Approved by sheathing manufacturer.
6. Warranty:
   a. Exposure: Manufacturer's standard; 12 months, against exposure damage, and dated from installation of product.
   b. Defect: Manufacturer's standard; 5 years, against manufacturing defects, and dated from purchase of product.
   c. Material: Manufacturer's standard; 5 years, dated from Date of Substantial Completion.

C. Wall Sheathing: Oriented strand board structural wood panel with factory laminated water-resistive and air barrier layer.

1. Sheathing Panel: PS 2, Exposure 1.
   a. Size: 4 feet wide by 8 feet long.
   b. Grade: Sheathing.
   c. Performance Category: 5/8 PERF CAT.
2. Integral Water-Resistive and Air Barrier: Sheet material qualifying as a Grade D water resistive barrier; complying with ICC-ES AC310.
3. Water Vapor Permeance of Water Resistive and Air Barrier: 12 to 16 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B.
4. Maximum Allowable Air Leakage of Assembly, complying with ASTM E2357:
   a. Infiltration: 0.0072 cfm per square foot, maximum, at a pressure differential of 1.57 pounds per square foot.
   b. Exfiltration: 0.0023 cfm per square foot, maximum, at a pressure differential of 1.57 pounds per square foot.
5. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
6. Seam Tape: Manufacturer's standard pressure-sensitive, self-adhering, cold-applied, seam tape.
7. Warranty: Manufacturer's standard 30 year limited system warranty of:
   a. Performance: Panel and tape resistance to water penetration; tape adhesion.

b. Material: Free from manufacturing defects and panel delamination.

D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

A. Fasteners and Anchors:
1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
2. Anchors: Toggle bolt type for anchorage to hollow masonry.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification Ausing waterborne preservative.
a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
b. Treat lumber exposed to weather.
c. Treat lumber in contact with masonry or concrete.
d. Treat lumber less than 18 inches above grade.
e. Treat lumber in other locations as indicated.
2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification Fusing waterborne preservative.
a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
b. Treat plywood in contact with masonry or concrete.
c. Treat plywood less than 18 inches above grade.
d. Treat plywood in other locations as indicated.
3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification Ausing waterborne preservative.
a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.
b. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.3 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
F. Provide the following specific non-structural framing and blocking:
    1. Cabinets and shelf supports.
    2. Wall brackets.
    3. Handrails.
    4. Grab bars.
    5. Towel and bath accessories.
    6. Wall-mounted door stops.
    7. Chalkboards and marker boards.
    8. Wall paneling and trim.
    9. Joints of rigid wall coverings that occur between studs.
    10. Wall Mounted Televisions.

3.4 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearingand staggered, using nails, screws, or staples.
B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
    1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
    2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
    3. Install adjacent boards without gaps.
C. Wall Sheathing with Laminated Water-Resistive Barrier and Air Barrier: Secure to studs as recommended by manufacturer.
    1. Install with laminated water-resistive and air barrier on exterior side of sheathing.
    2. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
    3. Use only mechanically attached and drainable EIFS and exterior insulation with wall sheathing with laminated water-resistive and air barrier.
    4. Apply manufacturer's standard seam tape to joints between sheathing panels. Use tape gun or hard rubber roller as recommended by manufacturer.

3.5 CLEANING

A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 062000 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Finish carpentry items.
B. Wood casings and moldings.

1.2 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
B. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
C. Section 064200 - Wood Paneling: Shop fabricated custom paneling.
D. Section 081416 - Flush Wood Doors.
E. Section 081433 - Stile and Rail Wood Doors.
F. Section 083200 - Sliding Glass Doors: Wood patio doors.
G. Section 085200 - Wood Windows.
H. Section 088000 - Glazing:
I. Section 099113 - Exterior Painting: Painting of finish carpentry items.
J. Section 099123 - Interior Painting: Painting of finish carpentry items.
K. Section 123530 - Residential Casework: Shop fabricated cabinet work.

1.3 REFERENCE STANDARDS

A. ANSI A135.4 - Basic Hardboard 2012 (R2020).
B. ANSI A208.1 - American National Standard for Particleboard 2016.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
D. AWI (QCP) - Quality Certification Program Current Edition.
E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
G. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
H. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
I. PS 1 - Structural Plywood 2009 (Revised 2019).
J. PS 20 - American Softwood Lumber Standard 2020.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. Product Data:
    1. Provide data on fire retardant treatment materials and application instructions.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
    1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
C. Samples: Submit two samples of finish plywood, 12 by 12 inch in size illustrating wood grain and specified finish.
D. Samples: Submit two samples of wood trim 6 inch long.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
   1. Provide air circulation around stacks and under coverings.
   2. Protect materials from weather by covering with waterproof sheeting, securely anchored.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least on coat of specified finish can be applied without exposure to rain, snow, or dampness

B. Do not install finish carpenty materials that are wet, moisture damaged, or mold damaged.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

A. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

B. Interior Woodwork Items:
   1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
   2. Door, Glazed Light, and Pocket Door Frames: White birch; prepare for paint finish.
   3. Window Sills: Clear fir; prepare for transparent finish.

2.2 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.3 SHEET MATERIALS

A. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.4 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Concealed Joint Fasteners: Threaded steel.

2.5 ACCESSORIES

A. Cellular PVC Trim and Moldings: Extruded, expanded PVC; UV-resistant, heat-stabilized, and rigid material; for exterior use only.
   1. Density: 31 pounds per cubic foot, minimum.
   2. Flame Spread: ASTM E84, 75, maximum.
   3. Manufacturers:
      a. AZEK Building Products, Inc: www.azek.com.
      b. CertainTeed Corporation; www.certainteed.com.
      c. Versatex Trimboard; a Wolfpac Technologies, Inc. company
      d. Vi-Lux Plastics Inc; www.vi-lux.com.

B. Aluminum Edge Trim: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; natural mill finish.

C. E. MDO Trim: Exterior Grade B-B MDO plywood.

D. Primer: Alkyd primer sealer.

E. Wood Filler: Solvent base, tinted to match surface finish color.

2.6 WOOD TREATMENT

A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.

B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450,

maximum, when tested in accordance with ASTM E84.

C. Provide identification on fire retardant treated material.

2.7 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Shop prepare and identify components for book match grain matching during site erection.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.8 SHOP FINISHING

A. Apply wood filler in exposed nail and screw indentations.

B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:
   a. System - 1, Lacquer, Nitrocellulose.
   b. Sheen: Flat.
2. Opaque:
   a. System - 1, Lacquer, Nitrocellulose.
   b. Color: As selected by Architect.
   c. Sheen: Flat.

C. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

C. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

3.3 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch.

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

3.4 ADJUSTING

A. Adjust joinery for uniform appearance.

3.5 CLEANING

A. 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

SECTION 071400 - FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-Applied Waterproofing:
   1. Polyurethane waterproofing.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete substrate.
B. Section 072100 - Thermal Insulation: Insulation used for protective cover.
C. Section 079200 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not part of work in this section.

1.3 REFERENCE STANDARDS

A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course 2018.
B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016, with Editorial Revision (2021).
C. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact 2020.
D. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).
E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers 2017.
F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
G. NRCA (WM) - The NRCA Waterproofing Manual 2005.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.
F. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with warranty conditions for the waterproofing membrane.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.
C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Polyurethane Waterproofing:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Construction Chemicals-Building Systems; MasterSeal HLM 5000: www.buildingsystems.basf.com or comparable product by one of the following:
      a. Carlisle Coatings & Waterproofing, Inc: www.carlisleccw.com/#sle.
      b. Gaco Western: www.gaco.com/#sle.
      c. Karnak Corporation; [____]: www.karnakcorp.com/#sle.
      d. Tremco Commercial Sealants & Waterproofing; TREMproof 250GC: www.tremcosealants.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.2 WATERPROOFING APPLICATIONS

A. Polyurethane Waterproofing:
   1. Location: Foundation Walls/Footings.
   2. Cover with drainage panel.

2.3 FLUID APPLIED WATERPROOFING MATERIALS

A. Polyurethane Waterproofing: Cold-applied one or two component polyurethane, complying with ASTM C836/C836M.
   1. Cured Thickness: 60 mils, 0.060 inch, minimum.
   2. Suitable for installation over concrete substrates.
   3. Tensile Strength: 400 psi, measured in accordance with ASTM D412.
   4. Ultimate Elongation: 180 percent, measured in accordance with ASTM D412.
   5. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240.
   6. Adhesion: Greater than 150 psi, measured in accordance with ASTM D4541.
   7. Brittleness Temperature: Based on minus 50 degrees F, measured in accordance with ASTM D746.

2.4 ACCESSORIES

A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.
B. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
   1. Composition: Dimpled polyethylene core; polypropylene or polyester filter fabric.
   2. Thickness: 1/4 inch, minimum.
C. Cant Strips: Premolded composition material.
D. Counterflashings: As recommended by membrane and protection board manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.
B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
E. Prepare building expansion joints at locations as indicated on drawings.
F. Install cant strips at inside corners.

3.3 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
B. Seal membrane and flashings to adjoining surfaces.
   1. Install termination bar along edges.

3.4 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.

3.5 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 071900 - WATER REPELLENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water repellents applied to exterior, masonry, stone, and concrete surfaces.

1.2 REFERENCE STANDARDS

A. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2020a.

B. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete 2013.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Architect.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard color samples.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate of each separate coat.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

F. Sample Warranty: For Special Warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience

C. Owner reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.6 FIELD CONDITIONS

A. Protect liquid materials from freezing.

B. Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellants to be applied according to manufacturer's written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours minimum.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted for 24 hours minimum.
6. Not less than 24 hours have passed since surfaces were wet.
7. Windy conditions do not exist that might cause water repellant to be blown onto vegetation or surfaces not intended to be treated.

1.7 WARRANTY

A. Provide five year manufacturer warranty for repair and/or replacement of materials that fail to maintain water repellency.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc., Siloxane PD or comparable product by one of the following:
      a. BASF Construction Chemicals: www.buildingsystems.basf.com/#sle.
      b. Pecora Corporation; KlereSeal 910-W/920-W Water-Based Penetrating Masonry Sealer: www.pecora.com/#sle.
      c. Tnemec Company, Inc: www.tnemec.com/#sle.
      d. Pecora Corporation: www.pecora.com.
      e. Sika Corporation: www.sika.com.

2.2 MATERIALS

A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
   1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
   2. VOC Content: Less than 400 g/L, when tested in accordance with ASTM D3960 or ASTM D5095.
   3. Moisture Absorption When Applied to Masonry: 80 percent minimum reduction, when tested in accordance with ASTM C140/C140M using masonry sample completely coated with water repellent.
   4. Moisture Absorption When Applied to Concrete: 80 percent minimum reduction, when tested in accordance with ASTM C642 concrete sample completely coated with water repellent.
   5. Moisture Absorption When Applied to Clay Brick: 80 percent minimum reducation, when tested in accordance with ASTM C67 brick sample completely coated with water repellant.
   6. Water Vapor Transmission: Comply with one or both of the following:
      a. Maximum 10 percent reduction water-vapor transmission of treated compared to untreated specimens, according to ASTM E 96/E 96M.
      b. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, according to ASTM D 1653.
   7. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E514/E514M.
   8. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G154 compared to water-repellent-treated specimens before weathering.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify joint sealants are installed and cured.
C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.2 PREPARATION

A. Protection of Adjacent Work:
   1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
   2. Protect adjacent surfaces not intended to receive water repellent.
B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.

C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
D. Remove loose particles and foreign matter.
E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.
F. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

3.3 APPLICATION

A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
B. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.

B. Batt insulation in exterior wall construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.

E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to 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 foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.6 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

C. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) board.

D. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation Perimeter Foundation/Slab Installation: Complies with ASTM C578 with either natural skin or cut cell surfaces.

1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
5. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
6. Manufacturers:
    a. Dow Chemical Company: www.dowbuildingsolutions.com/#sle.
    b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
    c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
    d. DiversiFoam Products; CertiFoam XPS: www.diversifoam.com

B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Complies with ASTM C578, and manufactured using carbon black technology.
1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Board Size: 48 inch by 96 inch.
6. Board Thickness: 2-3/16 inch.
7. Board Edges: Shiplap, at long edges.
8. Type and Water Absorption: Type XII, 0.3 percent by volume, maximum, by total immersion.
9. Manufacturers:
    a. DuPont de Nemours, Inc; STYROFOAM Brand Ultra SL (Shiplap): www.building.dupont.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

C. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Complies with ASTM C578, and manufactured using carbon black technology.
1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
5. Board Size: 15-3/4 inch by 96 inch.
6. Board Thickness: 2-3/16 inch.
7. Board Edges: Square.
8. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
9. Manufacturers:
    a. DuPont de Nemours, Inc; STYROFOAM Brand CAVITYMATE Ultra: www.building.dupont.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

2.3 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.

1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Manufacturers:
    a. CertainTeed Corporation; <>: www.certainteed.com/#sle.
    b. Johns Manville; <>: www.jm.com/#sle.
    c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
    d. Knauf Insulation.
    e. Substitutions: See Section 016000 - Product Requirements.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:
1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

C. Clean substrate of substances that are harmvul to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.3 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.
1. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.4 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. 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.

3.5 BOARD INSTALLATION AT CAVITY WALLS

A. Install boards to fit snugly between wall ties.

B. Install boards horizontally on walls.
   1. Install in running bond pattern.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
D. 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.

3.6 BOARD INSTALLATION AT CONCRETE SLABS

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 24 inches in from exterior walls.
   2. Place insulation under slabs on grade after base for slab has been compacted.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
D. Prevent insulation from being displaced or damaged whileplacing vapor retarder and placing slab.

3.7 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.
B. Install in exterior wall and ceiling spaces without gaps or voids. Do not compress insulation.
C. 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.
D. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
E. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
F. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
G. 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.
H. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

3.9 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.
B. Protect installed insulation 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

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. In exterior wall crevices.
   3. Below or between roof framing.
   4. At junctions of dissimilar wall and roof materials.
B. Foamed-in-place intumescent insulation.
C. Protective intumescent coating.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.
B. ASTM C1029 - Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation 2020.
C. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics 2016.
D. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics 2020.
E. ASTM D1623 - Standard Test Method for Tensile And Tensile Adhesion Properties of Rigid Cellular Plastics 2017.
F. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics 2019.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
J. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Provide record of pre-installation meeting in the form of meeting agenda and/or meeting notes. Submit record to Architect as an information submittal.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.

1.6 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.1 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, open or closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and overcoat limitations.
   2. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
   3. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
   4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
   5. Air Permeance: 0.04 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf.
   6. Closed Cell Content: At least 90 percent.
   7. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
   8. Basis of Design:
      a. Icynene-Lapolla; Icynene ProSeal LE: www.icynene.com/#sle.
   9. Other Acceptable Manufacturers:
      a. Accella Polyurethane Systems: www.accellapolyurethane.com/#sle.
      b. BASF Corporation: www.spf.basf.com/#sle.
      c. Henry Company; <>: www.henry.com/#sle.
      d. Johns Manville: www.jm.com/#sle.
      e. Demilec Inc.
   10. Substitutions: See Section 016000 - Product Requirements.

B. Monolithic Foamed-In-Place Intumescent Insulation: Medium-density, semi-rigid, two-part, closed cell polyurethane foam; foamed on-site using blowing agent of non-ozone-depleting gas.
   1. Regulatory Requirements: Conform to applicable code and ICC-EC Evaluation Report for flame and smoke, concealment, and overcoat limitations.
   2. Thermal Resistance: R-value of 4.6, minimum, per 1 inch thickness at 140 degrees F mean temperature, at 90 days, when tested in accordance with ASTM C518.
   3. Water Vapor Permeance: 0.99 perms, maximum, when tested at 2.4 inch thickness in accordance with ASTM E96/E96M.
   4. Air Permeance: 0.0014 cfm/sq ft, maximum, when tested at 1-1/4 inch thickness in accordance with ASTM E2178 or ASTM E283 at 1.57 psf.
   5. Closed Cell Content: At least 90 percent.
   6. Density: 2.0 lbs/cu ft, nominal, in accordance with ASTM D1622/D1622M.
   7. Tensile Strength: 28 psi, minimum, in accordance with ASTM D1623.
   8. Compressive Strength: 22 psi, minimum, in accordance with ASTM D1621.
   9. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/300, maximum, at 4 inch thick when tested in accordance with ASTM E84.
   10. Manufacturers:
      a. Preferred Solutions, Inc; Staycell ONE STEP 255 Spray Foam Insulation
   11. Substitutions: See Section 016000 - Product Requirements.

2.2 ACCESSORIES

A. Primer: As required by insulation manufacturer.

B. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes and ICC-ES Evaluation Report.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.
B. Verify that surfaces are clean, dry, and free of matter that are harmful to insulation and insulation adhesion.

3.2 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.
B. Apply primer as required and in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Apply to achieve a thermal resistant R-Value as indicated in drawings.
D. Apply in multiple passes not to exceed maximum thickness as reccomended and required by manufacturer. Do not spray into rising foam.
E. Patch damaged areas.
F. Where applied to voids and gaps assure that foam has space for expansion to avoid pressure on adjacent materials that may bind operable parts.
G. Trim excess insulation away for applied trim or remove as required for continuous sealant bead.

3.4 FIELD QUALITY CONTROL

A. Inspect and verifyr that insulationand overcoat thickness and density comply with applicable building code and ICC-ES Evaluation Report.

3.5 PROTECTION

A. Do not permit subsequent construction work or harmful weather to disturb applied insulation.

END OF SECTION

SECTION 072126 - BLOWN INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

1.2 REFERENCE STANDARDS

A. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation 2019.

B. ASTM C1015 - Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation 2017.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Blown Insulation:

1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville; [_____]: www.jm.com/#sle.
3. Thermafiber, Inc; [_____]: www.thermafiber.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

A. Applications: Provide blown insulation in interior walls as indicated on drawings.

B. Provide blown insulation in accordance with requirements of Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

C. Blown Insulation: ASTM C764, fiberglass type, nodulated for pour and bulk for pneumatic placement.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate and adjacent materials are dry and ready to receive insulation.

B. Verify spaces are unobstructed to allow for proper placement of insulation.

3.2 INSTALLATION

A. Install insulation in accordance with ASTM C1015 and manufacturer's instructions.

B. Completely fill intended spaces leaving no gaps or voids.

END OF SECTION

SECTION 072500 - WEATHER BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
B. Section 061000 - Rough Carpentry: Water-resistive barrier under exterior cladding.
C. Section 072400 - Exterior Insulation and Finish Systems: Water-resistive barrier under exterior insulation.

1.3 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
C. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.4 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016, with Editorial Revision (2021).
B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2020.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.5 SUBMITTALS

A. Product Data: Provide data on material characteristics, performance criteria, and limitations.

1.6 QUALITY ASSURANCE

A. A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 MOCK-UP

A. Install air barrier materials in mock-up to set quality standards for materials and execution.
    1. Build integrated mockups of exterior wall assembly , 150 sq. ft., 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.
        a. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

1.8 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.1 WEATHER BARRIER ASSEMBLIES

A. Air Barrier:

1. On outside surface of inside wythe of exterior masonry cavity walls use air barrier coating.
2. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.

2.2 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      a. Air Permeance: 0.001 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
      b. Water Vapor Permeance: 18 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.
      c. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for up to 6 months of weather exposure after application.
      d. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
      e. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      f. Complies with NFPA 285 wall assembly requirements.
      g. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
      h. VOC Content: 100 g per L or less.
      i. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
      j. Products: Subject to compliance with requirements, provide one of the following:
         1) DuPont Building Innovations; Tyvek Fluid Applied WB+ with Tyvek Fluid Applied Flashing and Joint Compound, Sealant for Tyvek Fluid Applied System and StraightFlash: www.dupont.com/#sle.
         2) Henry Company; Air-Bloc 17MR: www.henry.com/#sle.
         3) Parex USA, Inc; Parex USA WeatherSeal Trowel-on (with gauging aggregate): www.parexusa.com/#sle.
         4) Parex USA, Inc; Parex USA WeatherSeal Spray & Roll-on: www.parexusa.com/#sle.
         5) PROSOCO, Inc; R-GUARD Cat 5: www.prosoco.com/r-guard/#sle.
         6) PROSOCO, Inc; R-GUARD Spray Wrap MVP: www.prosoco.com/r-guard/#sle.
         7) Sto Corp; Sto Gold Coat: www.stocorp.com/#sle.
         8) Substitutions: See Section 016000 - Product Requirements.

2.3 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
   1. Composition: Any material that meets physical requirements of ASTM D1970/D1970M with exceptions indicated.
   2. Manufacturers:
      a. DuPont Building Innovations; FlexWrap NF: www.dupont.com/#sle.
      b. DuPont Building Innovations; StraightFlash: www.dupont.com/#sle.
      c. DuPont Building Innovations; StraightFlash VF: www.dupont.com/#sle.
      d. Fortifiber Building Systems Group; FortiFlash: www.fortifiber.com/#sle.
      e. Fortifiber Building Systems Group; FortiFlash Commercial: www.fortifiber.com/#sle.
      f. Fortifiber Building Systems Group; FortiFlex: www.fortifiber.com/#sle.

g. Fortifiber Building Systems Group; FortiFlash Butyl: www.fortifiber.com/#sle.
h. SIGA Cover Inc; SIGA-Wigluv: www.sigacover.com/#sle.
i. Substitutions: See Section 016000 - Product Requirements.

C. Liquid Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.
1. Manufacturers:
a. BASF Corporation; MasterSeal AWB 900: www.master-builders-solutions.basf.us/#sle.
b. Master Wall Inc; SuperiorFlash: www.masterwall.com/#sle.
c. Pecora Corporation; [_____]: www.pecora.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

D. Stainless Steel Flashing: Flexible flashing with 8 mil, 0.008 inch thick sheet of Type 304 stainless steel, 8 mil, 0.008 inch of butyl adhesive and a siliconized release liner.
1. Roll Length: 50 feet long.
2. Width: 6 inch wide.
3. Overlap joints at least 2 inch.

E. Termite-Resistant Barrier Seam and Window Flashing: Peel and stick flashing membrane; polyethylene film bonded to sealant.
1. Thickness: 40 mil, 0.040 inch overall.
2. Roll Width: 4 inch.
3. Manufacturers:
a. Polyguard Barrier Systems, Inc, a division of Polyguard Products, Inc; TERM Seam and Window Barrier: www.polyguardbarriers.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

F. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

D. Coatings:
1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.
3. Use flashing to seal to adjacent construction and to bridge joints.

E. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.4 FIELD QUALITY CONTROL

A. Do not cover installed weather barriers until required inspections have been completed.

B. Take digital photographs of each portion of the installation prior to covering up.

3.5 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Adhered system with thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Flashings.
D. Roofing stack boots, roofing expansion joints, and walkway pads.

1.2 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood nailers and curbs.
B. Section 076200 - Sheet Metal Flashing and Trim: Counterflashings, reglets and [_____].
C. Section 077200 - Roof Accessories: Roof-mounted units; prefabricated curbs.

1.3 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2020.
C. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method 1983 (Reapproved 2018).
D. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing 2019.
E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.
F. FM DS 1-28 - Wind Design 2016.
G. NRCA (RM) - The NRCA Roofing Manual 2019.
H. NRCA (WM) - The NRCA Waterproofing Manual 2005.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
    1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.
C. Shop Drawings: Submit drawings that indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.
F. Warranty Documentation:
    1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
    2. Submit installer's certification that installation complies with warranty conditions for waterproof membrane.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.9 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 100 degrees F.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within five years after installation.

C. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.

1. Warranty Term: 20 years.
2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:

1. Carlisle Roofing Systems, Inc; Sure-Weld TPO: www.carlisle-syntec.com/#sle.
2. Firestone Building Products, LLC; UltraPly 60 mil: www.firestonebpco.com.
3. GAF; EverGuard TPO60 mil: www.gaf.com/#sle.
4. Johns Manville; 60 mil: www.jm.com/#sle.
5. Versico, a division of Carlisle Construction Materials Inc; VersiWeld TPO: www.versico.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

2.2 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

A. Membrane Roofing Materials:

1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
   a. Thickness: 60 mil, 0.060 inch, minimum.
2. Thickness: 0.060 inch, minimum (60 mils).
3. Sheet Width: Factory fabricated into largest sheets possible.
4. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.

2.3 COVER BOARDS

A. Deck Sheathing: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.

1. Thickness: 5/8 inch, Type X, fire-resistant.
2. Manufacturers:

a. Georgia-Pacific; DensDeck: www.densdeck.com/#sle.
b. National Gypsum Company; DEXcell Glass Mat Roof Board: www.nationalgypsum.com/#sle.
c. National Gypsum Company; DEXcell FA Glass Mat Roof Board: www.nationalgypsum.com/#sle.
d. USG Corporation; Securock Ultralight Glass-Mat Roof Board or Securock Ultralight Coated Glass-Mat Roof Board: www.usg.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

2.4 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
a. Type II:
1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
2) Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
3) Thermal Resistance, R-value: At 1-1/2 inch thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.
2. Board Size: 48 by 96 inch.
3. Board Thickness: 3.0 inch.
4. Tapered Board: Slope as indicated; minimum thickness 1/4 inch; fabricate of fewest layers possible.
5. Board Edges: Square.

2.5 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
C. Membrane Adhesive: As recommended by membrane manufacturer.
D. Insulation Adhesive: As recommended by insulation manufacturer.
E. Sealants: As recommended by membrane manufacturer.
F. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
1. Composition: Roofing membrane manufacturer's standard.
2. Size: 30 inch.
3. Surface Color: White or yellow.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.2 PREPARATION - CONCRETE DECK

A. Verify adjacent precast concrete roof members do not vary more than 1/4 inch in height. Verify grout keys are filled flush.

B. Fill surface honeycomb and variations with latex filler.
C. Do not begin work until elevated concrete substrate has cured at least 28 days and moisture content is five percent or less.
    1. Test as Follows:
        a. Concrete Moisture Content: No beading water under plastic after 16 hours when tested in accordance with ASTM D4263.
        b. Relative Humidity in Concrete: Not greater than 75 percent when tested in accordance with ASTM F2170.

3.3 INSTALLATION, GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
B. Do not apply roofing membrane during cold or wet weather conditions.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
F. Coordinate this work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

3.4 INSULATION - UNDER MEMBRANE

A. Attachment of Insulation:
    1. Mechanically fastenfirst layer of insulation to deck in accordance with roofing manufacturer's instructionsand Factory Mutual requirements.
    2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
B. Lay subsequent layers of insulation with joints staggered minimum 12 inch from joints of preceding layer.
C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
D. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.
G. Do not install more insulation than can be covered with membrane in same day.

3.5 INSTALLATION - MEMBRANE

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Apply adhesive to substrate at rate of 0.02 gal/sq ft. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Install uniform bead of sealant to joint edge.
E. At intersections with vertical surfaces:
    1. Extend membrane over cant strips and up a minimum of 12 inches onto vertical surfaces.
    2. Fully adhere flexible flashing over membrane and up to nailing strips.
    3. Secure flashing to nailing strips at 4 inches on center.

4. Insert flashing into reglets and secure.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Install roofing expansion joints where indicated. Make joints watertight.

1. Install prefabricated joint components in accordance with manufacturer's instructions.

H. Coordinate installation of roof drains and sumps and related flashings.

3.6 FINISHING SURFACES

A. Install walkway pads. Space pad joints to permit drainage.

3.7 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.8 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and counterflashings.
B. Sealants for joints within sheet metal fabrications.
C. Precast concrete splash pads.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
F. CDA A4050 - Copper in Architecture - Handbook current edition.
G. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
B. Samples: Submit two samples __6"__by___6"_ inch in size illustrating metal finish color.
C. Closeout
    1. Maintenance data.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years ofdocumented experience.

1.7 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. Finish Warranty Period: 20 years from date of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
    1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
    2. Color: As selected by Architect from manufacturer's full colors.

B. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) thick; smooth No. 4 - Brushed finish.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
G. Fabricate flashings to allow toe to extend 4" inches over roofing substrate. Return and brake edges.

2.3 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
E. Plastic Cement: ASTM D4586/D4586M, Type I.
F. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.
B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
C. Apply plastic cement compound between metal flashings and felt flashings.
D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
E. Seal metal joints watertight.
F. Slope gutters 1/8" inch per 10' feet, minimum.
G. Connect downspouts to downspout boots, and seal connection watertight.

END OF SECTION

SECTION 077100 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured roof specialties, including copings and fascias.

1.2 RELATED REQUIREMENTS

A. Section 077200 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.3 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems 2017.

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

D. NRCA (RM) - The NRCA Roofing Manual 2019.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

D. Samples: Submit two appropriately sized samples of coping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Roof Edge Flashings and Copings:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. ATAS International, Inc; Continuous Cleat Coping:
   b. ATAS International, Inc; Drip Edge Fascia:
   c. Metal-Era Inc:
   d. Substitutions: See Section 016000 - Product Requirements.
2. Roof Edge Flashings and Copings to be compliant with roof manufacturers roof warranty.

2.2 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.

1. Configuration: Fascia, and edge securement for roof membrane.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
3. Material: Formed steel sheet, galvanized, 24 gage, 0.024 inch thick, minimum.
4. Finish: 70 percent polyvinylidene fluoride.
5. Color: To be selected by Architect from manufacturer's full range.

B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.

1. Configuration: Concealed hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
3. Material: Formed steel sheet, galvanized, 24 gage, 0.024 inch thick, minimum.

4. Finish: 70 percent polyvinylidene fluoride.
5. Color: To be selected by Architect from manufacturer's full range.

2.3 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.4 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
C. Roof Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
1. Refer to Section 077200 for information on roofing related accessories.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
F. Coordinate installation of flashing flanges into reglets.

END OF SECTION

SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Curbs.
B. Equipment rails.
C. Roof penetrations mounting curbs.
D. Non-penetrating pedestals.
E. Snow guards.

1.2 RELATED REQUIREMENTS

A. Section 053100 - Steel Decking.
B. Section 076200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.
C. Section 075423 Thermoplastic Polyolefin (TPO) Membrance Roofing
D. Section 077100 - Roof Specialties: Other manufactured roof items.

1.3 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders current edition.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
E. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used.
    1. Preparation instructions and recommendations.
    2. Storage and handling requirements and recommendations.
    3. Installation methods.
B. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
    1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
    2. Snow Guards: Submit design calculations for loadings and spacings based on manufacturer testing.
C. Closeout
    1. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.
D. Warranty Documentation:
    1. Submit manufacturer warranty.
    2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
    3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

1.6 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ROOF CURBS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. AES Industries Inc.
   2. The Pate Company
   3. LMCurbs; Roof Curbs
   4. Roof Products & Systems (RPS)
   5. Substitutions: See Section 016000 - Product Requirements.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of corrugated metal roof deck with insulation.
   2. Sheet Metal Material:
   3. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G90 coating designation; 18 gage, 0.048 inch thick.
   4. Provide layouts and configurations indicated on drawings.

C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
   3. Height Above Finished Roof Surface: 12" inches, minimum.

D. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
   1. Provide preservative treated wood nailers along top of rails.
   2. Height Above Finished Roof Surface: 12" inches, minimum.

E. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.
   1. Provide preservative treated wood nailers over entire top surface, for supports that are provided by others.
   2. Height Above Finished Roof Surface: 12" inches, minimum.

2.2 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
   3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
   6. Manufacturers:
      a. PHP Systems/Design; <>: www.phpsd.com/#sle.
      b. Portals Plus; [_____]: www.portalsplus.com/#sle.

B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.

1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
2. See relevant piping system specification section for additional requirements.

C. Duct Supports: Provide extruded aluminum supports and sized in accordance with diameter of supported ducts, and with base that is non-penetrating of roofing membrane.

D. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
1. Bases: High density polypropylene.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

2.3 SNOW GUARDS

A. Fence Type Snow Guard: Continuous snow guard; manufacturer's standard pipe, bar, channel, or solid rod, set in brackets or posts, with optional plates and metal trim to match roof.
1. Extruded Aluminum Channel: Manufacturer's standard shape; with slot for insertion of metal trim matching roof.
2. Supplemental Plates and Clips: Attached to horizontal component; match finish of pipe, tube, rod, or channel.
3. Clamps for Standing Seam Roof: Aluminum clamps attached to standing seams of roof panels; for attachment of fence type snow guard.
a. Seam Profile: Selected by Architect from manufacturer's standard range; match profile of metal roof.
4. Basis of Design Product: Subject to compliance with requirements, provide PMC Industries, Inc; AceClamp - ColorSnap Snow Retention System or a comparable product by one of the following:
a. Berger Building Products
b. LMCurbs
c. Metal Roof Innovations, Ltd.
d. Rocky Mountain Snow Guards, Inc
e. TRA Snow and Sun
f. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4 CLEANING

A. Clean installed work to like-new condition.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 078100 - APPLIED FIRE PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fireproofing of interior structural steel not exposed to damage or moisture.
B. Fireproofing of structural steel exposed to damage or moisture.
C. Preparation of fireproofing for application of exposed finish specified elsewhere.

1.2 RELATED REQUIREMENTS

A. Section 051200 - Structural Steel Framing.
B. Section 052100 - Steel Joist Framing.
C. Section 053100 - Steel Decking.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
B. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members 2019.
C. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members 1992 (Reapproved 2020).
D. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members 1993 (Reapproved 2020).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittals procedures.
B. Product Data: Provide data indicating product characteristics.
C. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, as follows:
    1. Bond strength.
    2. Bond impact.
    3. Compressive strength.
    4. Fire tests using substrate materials similar those on project.
D. Manufacturer's Installation Instructions: Indicate special procedures.
E. Manufacturer's Qualification Statement.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 MOCK-UP

A. Construct mock-up, 100 square feet in size.
B. Comply with project requirements for fire ratings.
C. Locate where directed.
D. Examine installation within one hour of application to determine variances from specified requirements due to shrinkage, temperature, and humidity.
E. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary; remove materials and re-construct mock-up.
F. Mock-up may remain as part of the Work.

1.7 FIELD CONDITIONS

A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.
B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.

C. Provide temporary enclosure to prevent spray from contaminating air.
D. Do not allow roof traffic during installation of roof fireproofing and drying period.

1.8 WARRANTY

A. Correct defective Work within a two year period after Date of Substantial Completion.
   1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
   2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Applied Fireproofing:
   1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
      a. GCP Applied Technologies:
      b. Isolatek International Corp:
      c. Southwest Fireproofing Products Company:
   2. Substitutions: See Section 016000 - Product Requirements.
   3. Verify acceptable manufacturers with UL assemblies indicated on drawings or under this specification.

2.2 FIREPROOFING ASSEMBLIES

A. Provide assemblies as indicated on drawings.

2.3 MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard factory mixed material, which when combined with water is capable of providing the indicated fire resistance, and conforming to the following requirements:
   1. Bond Strength: 150 pounds per square foot, minimum, when tested in accordance with ASTM E736/E736M when set and dry.
   2. Compressive Strength: 8.33 pounds per square inch, minimum.
   3. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
   4. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
   5. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.

2.4 ACCESSORIES

A. Primer Coating: Of type recommended by fireproofing manufacturer.
B. Overcoat: As recommended by manufacturer of applied fireproofing material.
C. Water: Clean, potable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive fireproofing.
B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
D. Verify that voids and cracks in substrate have been filled.
E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.2 PREPARATION

A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
F. Close off and seal duct work in areas where fireproofing is being applied.

3.3 APPLICATION

A. Apply primer adhesive in accordance with manufacturer's instructions.
B. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.
C. Apply overcoat at the rate recommended by fireproofing manufacturer.

3.4 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with Section 014000 - Quality Requirements.
B. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
C. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of authorities having jurisdiction (AHJ).
D. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.5 CLEANING

A. Remove excess material, overspray, droppings, and debris.
B. Remove fireproofing from materials and surfaces not required to be fireproofed.
C. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION

SECTION 078400 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 RELATED REQUIREMENTS

A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.3 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).

C. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).

D. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.

E. ITS (DIR) - Directory of Listed Products current edition.

F. FM (AG) - FM Approval Guide current edition.

G. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

H. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

I. UL (DIR) - Online Certifications Directory Current Edition.

J. UL (FRD) - Fire Resistance Directory Current Edition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.5 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.6 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the specified fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Installer Qualifications: Company specializing in performing the work of this section and:

1. Trained by manufacturer.
2. Verification of minimum three years documented experience installing work of this type.
3. Verification of at least five satisfactorily completed projects of comparable size and type.

1.7 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. 3M Fire Protection Products: www.3m.com/firestop.
   2. A/D Fire Protection Systems Inc: www.adfire.com.
   3. Hilti, Inc: www.us.hilti.com.
   4. Specified Technologies Inc: www.stifirestop.com.
   5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
   6. Thermafiber, Inc.: wwwthermafiber.com..

2.2 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

D. Fire Ratings: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed. Refer to drawings for fire-resistance ratings.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
   2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS

A. Firestopping: Penetrations in Fire-Resistance-Rated Walls.
   1. Fire Ratings: Use any system that is listed by UL (FRD) and tested in accordance with ASTM E814 or UL 1479 with F Rating equal to fire rating of penetrated assembly andminimum T Rating Equal to F Rating and in compliance with other specified requirements.

B. Firestopping: Penetrations in Horizontal Assemblies.
   1. Fire Ratings: Use any system that is listed by UL (FRD) and tested in accordance with ASTM E814 or UL 1479 with F Rating of at least one hour, but not less than the fire rating of penetrated assembly andminimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.

3.3 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

3.4 FIELD QUALITY CONTROL

A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonsag gunnable joint sealants.
B. Self-leveling pourable joint sealants.
C. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping: Firestopping sealants.
B. Section 087100 - Door Hardware: Setting exterior door thresholds in sealant.
C. Section 088000 - Glazing: Glazing sealants and accessories.
D. Section 092216 - Non-Structural Metal Framing: Sealing between framing and adjacent construction in acoustical and sound-rated walls and ceilings.
E. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.3 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.
B. ASTM C834 - Standard Specification for Latex Sealants 2017.
C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2018.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
G. ASTM C1311 - Standard Specification for Solvent Release Sealants 2014.
H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).
I. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016, with Editorial Revision (2021).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation conference: Conduct conference at Project Site.

1.5 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
    1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
    2. List of backing materials approved for use with the specific product.
    3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
    4. Substrates the product should not be used on.
    5. Substrates for which use of primer is required.
    6. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
    7. Sample product warranty.
B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required

sealant.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

1.7 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.2 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    a. Wall expansion and control joints.
    b. Joints between door, window, and other frames and adjacent construction.
    c. Joints between different exposed materials.
    d. Openings below ledge angles in masonry.
    e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    a. Joints between door, window, and other frames and adjacent construction.
    b. Other joints indicated below.
3. Do not seal the following types of joints.
    a. Intentional weepholes in masonry.
    b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    d. Joints where installation of sealant is specified in another section.
    e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.

7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.3 JOINT SEALANTS - GENERAL

A. Colors: As selected by Architect from manufacturer's full range.

2.4 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses NT; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   5. Color: To be selected by Architect from manufacturer's standard range.
   6. Cure Type: Single-component, neutral moisture curing.
   7. Service Temperature Range: minus 55 to 250 degrees F degrees F.
   8. Basis of Design Product: Subject to compliance with requirements, provide Dow Corning Corporation 790 Silicone Building Sealant or comparable product by one of the following:
      a. Dow Corning Corporation; 790 Silicone Building Sealant: www.dowcorning.com/construction.
      b. Pecora Corporation; <>: www.pecora.com/#sle.
      c. Sika Corporation; Sikasil WS-290: www.usa-sika.com.
      d. Sika Corporation; Sikasil 728NS: www.usa-sika.com/#sle.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
      f. Tremco Commercial Sealants & Waterproofing; Tremsil 200: www.tremcosealants.com/#sle.
      g. GE Construction Sealants SCS2700 SilPruf LM.
      h. Substitutions: See Section 016000 - Product Requirements.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses NT; single or multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 35 percent, minimum.
   2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Service Temperature Range: Minus 40 to 180 degrees F.
   5. Basis of Design Product: Subject to compliance with requirements, provide BASF Corp. - Construction Chemicals; MasterSeal NP 1 or comparable product by one of the following:
      a. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
      b. Sika Corporation; Sikaflex-15 LM: www.usa-sika.com/#sle.
      c. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
      d. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC: www.tremcosealants.com/#sle.
      e. W. R. Meadows, Inc; POURTHANE NS: www.wrmeadows.com/#sle.
      f. Substitutions: See Section 016000 - Product Requirements.

C. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses A, M, T and NT; multi-component; explicitly approved by manufacturer for continuous water immersion;

suitable for traffic exposure when recessed below traffic surface .

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Basis of Design Product: Subject to compliance with requirements, provide BASF Corp. - Construction Chemicals; MasterSeal NP 2 or comparable product by one of the following:
    a. Sika Corporation: www.usa-sika.com.
    b. Pecora Corporation: www.pecora.com..
    c. Substitutions: See Section 016000 - Product Requirements.

D. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.

E. Epoxy Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

1. Hardness Range: 65 to 75, Shore A, when tested in accordance with ASTM C661.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Service Temperature Range: Minus 40 to 180 degrees F.

F. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

1. Color: To be selected by Architect from manufacturer's standard range.
2. Grade: ASTM C834; Grade - Minus 18 Degrees C.
3. Manufacturers:
    a. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com/#sle.
    b. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: www.us.hilti.com/#sle.
    c. Pecora Corporation; <>: www.pecora.com/#sle.
    d. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.
    e. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke & Sound: www.tremcosealants.com/#sle.
    f. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke & Sound Spray: www.tremcosealants.com/#sle.
    g. Substitutions: See Section 016000 - Product Requirements.

G. Butyl Sealant: Rubber-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.

1. Hardness Range: 10 to 30, Shore A, when tested in accordance with ASTM C661.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Service Temperature Range: Minus 13 to 180 degrees F.
4. Basis of Design Product: Subject to compliance with requirements, provide Pecora Corporation; BC-158 or comparable product by one of the following:
    a. Bostik, Inc.: www.bostik.com..

2.5 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .

1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: Gray.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Manufacturers:
    a. Pecora Corporation; <>: www.pecora.com/#sle.
    b. The QUIKRETE Companies; QUIKRETE® Polyurethane Self-Leveling Sealant: www.quikrete.com/#sle.
    c. Sika Corporation; Sikaflex-1c SL: www.usa-sika.com/#sle.
    d. Sika Corporation; Sikaflex-2c SL: www.usa-sika.com/#sle.
    e. Substitutions: See Section 016000 - Product Requirements.

B. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T, M and O; multi-component; explicitly approved by manufacturer for horizontal expansion joints.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Tensile Strength: 200 to 250 psi in accordance with ASTM D412.
5. Manufacturers:
    a. Tremco Commercial Sealants & Waterproofing; THC-901: www.tremcosealants.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

C. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
1. Movement Capability: Plus and minus 25 percent, minimum.

D. Flexible Polyurethane Foam: Single-component, gun grade, and low-expanding.
1. Manufacturers:
    a. DAP Products Inc; DRAFTSTOP 812 Foam: www.dapspecline.com/#sle.
    b. Tremco Commercial Sealants & Waterproofing; ExoAir Flex Foam: www.tremcosealants.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.

E. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
1. Composition: Multi-component, 100 percent solids by weight.
2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
3. Color: To be selected by Architect from manufacturer's standard colors.
4. Joint Width, Minimum: 1/8 inch.
5. Joint Width, Maximum: 1/4 inch.
6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
7. Manufacturers:
    a. Dayton Superior Corporation; [_____]: www.daytonsuperior.com/#sle.
    b. Euclid Chemical Company; EUCO 700: www.euclidchemical.com/#sle.
    c. Nox-Crete; DynaFlex 502: www.nox-crete.com/#sle.
    d. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com/#sle.
    e. Substitutions: See Section 016000 - Product Requirements.

2.6 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
   2. Basis of Design Product: Subject to compliance with requirements, provide BASF Corp. - Construction Chemicals; MasterSeal 920 & 921 or comparable product by one of the following:
      a. Nomaco, Inc: www.nomaco.com.
      b. Adfast Corporation: www.adfastcorp.com..
      c. Alcot Plastics, Ltd.: www.alcotplastics.com

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

END OF SECTION

SECTION 079513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion joint cover assemblies for floor and wall surfaces.

1.2 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.

C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles 2020.

D. ITS (DIR) - Directory of Listed Products current edition.

E. UL (DIR) - Online Certifications Directory Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.4 SUBMITTALS

A. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and [_____].

B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and [_____].

C. Samples: Submit two samples [____] inch long, illustrating profile, dimension, color, and finish selected.

D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

E. Expansion Joint Schedule: Prepared by or under the supervision of the supplier. Include the follwing information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.
2. Expansion joint cover assembly cross-referenced to Drawings.
3. Nominal, minimum, and maximum joint width.
4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings as applicable.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.5 CLOSEOUT SUBMTITALS

A. Owner's Manuals and Maintenance Instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Expansion Joint Cover Assemblies:

1. BASF Corporation - Watson Bowman Acme Corporation
2. Inpro.
3. Nystrom, Inc..

2.2 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.

1. Joint Dimensions and Configurations: As indicated on drawings.

2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
3. Joint Cover Styles: As indicated on drawings.
4. Joint Movement Capability: If not indicated on drawings, provide minimum plus/minus 25 percent joint movement capability.
5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

B. Floor Joint Covers: Coordinate with indicated floor coverings.
1. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.

C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.

D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.

E. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.
1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

2.3 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
1. Exposed Finish Outdoors: Natural anodized.
2. Exposed Finish at Floors: Mill finish or natural anodized.
3. Exposed Finish at Walls and Ceilings: Natural anodized.

B. Resilient Seals:
1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
3. Color: Gray.

C. Anchors and Fasteners: As recommended by cover manufacturer.

D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.

E. Threaded Fasteners: Aluminum.

F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

G. Nonmetallic, shrinkage-resistant grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint. Provide as indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.2 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Repair or grout block cores as required for continuous frame support using non-metallic, shrinkage resistant grout.

C. Align work plumb and level, flush with adjacent surfaces.

D. Rigidly anchor to substrate to prevent misalignment.

E. Install frames in continuous contact with adjacent surfaces. The use of shims is not permitted.

F. Install with hairline mitered corners where expansion joint cover assemblies change direction.

G. Terminate exposed ends of expansion joint cover assemblies with factory-fabricated termination devices when offered by manufacturer. Terminate exposed ends with field-fabricated if manufacturer does not offer termination devices.

3.3 CONNECTIONS

A. Transition Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with reoof expansion joint covers as applicable. Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joist cover assemblies.

3.4 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

B. Provide strippable coating to protect finish surface.

END OF SECTION

SECTION 080671 - DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preliminary schedule of door hardware sets for swinging and other door types as indicated on drawings.

1.2 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware: Requirements to comply with in coordination with this section.

1.3 REFERENCE STANDARDS

A. BHMA (CPD) - Certified Products Directory Current Edition.
B. BHMA A156.3 - American National Standard for Exit Devices 2014.
C. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks 2014.
D. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000 2017.
E. BHMA A156.18 - American National Standard for Materials and Finishes 2016.
F. DHI (H&S) - Sequence and Format for the Hardware Schedule 1996.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Comply with submittal requirements as indicated in Section 087100.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Only manufacturers listed in Door Hardware Schedule or Section 087100 are considered acceptable, unless noted otherwise.
B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.
C. Products are listed and certified compliant with specified standards by BHMA (CPD).
D. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 087100.
    1. AR - Adams Rite.
    2. BAS - Best Access Systems.
    3. BOM - Bommer Industries.
    4. CR - Corbin Russwin.
    5. CRL - C. R. Laurence.
    6. CUR - Curries.
    7. DTX - Detex.
    8. DMA - Dorma.
    9. FC - Falcon.
    10. FOR - Forms+Surfaces.
    11. GJ - Glynn Johnson.
    12. HGR - Hager.
    13. HES - HES.
    14. HG - Hettich Grant.
    15. HIA - Hiawatha.
    16. IVE - Ives.
    17. JOH - Johnson Hardware.
    18. KNX - Knox Company.
    19. LCN - LCN.
    20. McK - McKinney.
    21. MED - Medeco.
    22. MKR - Markar.
    23. NGP - National Guard Products.
    24. NOR - Norton.

25. PEM - Pemko.
26. PH - Precision Hardware.
27. RIX - Rixson.
28. ROC - Rockwood.
29. SA - Sargent.
30. SCH - Schlage.
31. SEC - Securitron.
32. SDC - Stanley Door Closers.
33. SH - Stanley Hinges.
34. STH - Stanley Commercial Hardware.
35. TR - Trimco.
36. VD - Von Duprin.
37. YA - Yale.
38. ZRO - Zero Industries, Inc.

2.2 DESCRIPTION

A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
   1. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
   2. Necessary items that are not included in a Hardware Set should be added and have the appropriate additional hardware as required for proper application and functionality.
   3. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
   4. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.3 LOCK FUNCTION CODES

A. Function Codes for Cylindrical Locks: Complying with BHMA A156.5.
   1. Code F75; Passage: Latch retracted by knobs/levers at all times.
   2. Code F76; Privacy Lock: Outside knob/lever locked by pushbutton on inside knob/lever. Rotating inside knob/lever or closing door releases/unlocks button. Emergency release in outside knob/lever.
   3. Code F81; Office Lock: Turn button locking. Turning button on inside locks outside knob/lever until unlocked by key or by rotating the inside knob/lever. Inside knob/lever always free. Deadlocking latch bolt.
   4. Code F82; Entry Lock: Push button locking. Button on inside locks outside knob/lever until unlocked by key or by rotating the inside knob/lever. Inside knob/lever always free. Deadlocking latch bolt.
   5. Code F84; Classroom Lock: Outside knob/lever locked/unlocked by key in outside knob/lever. Inside knob/lever always free. Deadlocking latchbolt.
   6. Code F86; Storeroom Lock: Outside knob/lever always locked/rigid. Latchbolt retracted by key in outside knob/lever or by rotating inside knob/lever. Inside knob/lever always free. Deadlocking latchbolt.
   7. Code F90; Dormitory Lock: Deadlocking latch bolt by levers except when locked by push button in inside lever. Key in outside lever locks or unlocks outside lever and releases button. Closing door releases push button. Inside lever always free.

B. Function Codes for Mortise Locks: Complying with BHMA A156.13.
   1. Code F01; Passage/Closet Latchset: Latch bolt by knobs at all times.

2. Code F02; Privacy Lock: Latch bolt by knobs, deadbolt by turn inside or emergency key outside.
3. Code F04: Entry/Office Lock: Deadlocking latch bolt by knobs except when outside knob is locked by buttons in face (edge), then by key outside.
4. Code F05; Classroom Lock: Deadlocking latch bolt by knobs. Outside knob locked by key outside. Inside knob always free.
5. Code F07; Storeroom/Exit Lock: Deadlocking latch bolt by inside knob or key outside. Outside knob rigid.
6. Code F08; Front Door Lock: Latch bolt is operated by knob from either side except when outside knob is made inoperative by a stop or mechanical means other than key. Deadbolt is operated by turn inside. Key outside operates both locks.
7. Codes F10, F12, and F20; Entry/Office Lock: Latch bolt by knobs except when outside knob is made inoperative by buttons in face. Deadbolt by key outside and turn inside. Rotating inside knob retracts both bolts. Deadlocking latch.
8. Code F13; Dormitory Lock: Latch bolt by knobs except when outside knob is locked by projecting deadbolt. Key outside retracts deadbolt and unlocks outside knob. Rotating inside knob retracts both bolts.

C. Function Codes for Exit Devices: Complying with BHMA A156.3.
1. Code 01; Exit Device: Exit only/no trim.
2. Code 02; Exit Device: Entrance by pull/trim when actuating bar is locked down (Dogged-Down). Note-Fire Exit devices cannot be locked down.
3. Code 03; Exit Device: Entrance by trim when latchbolt is retracted by key (pullside). Unit is locked when the key is removed.
4. Code 04; Exit Device: Entrance by trim when latchbolt is retracted by key (pullside) or set in a retracted position by key.
5. Code 05; Exit Device: Entrance by thumbpiece. Key (pullside) locks/unlocks thumbpiece.
6. Code 06; Exit Device: Entrance by thumbpiece only when released by key (pullside). Unit is locked when the key is removed.
7. Code 07; Exit Device: Entrance by thumbpiece. Inside key (on pushside/on active device case) locks/unlocks thumbpiece. Outside key (pullside) retracts latch.
8. Code 08; Exit Device: Entrance by knob/lever. Key (pullside) locks/unlocks knob/lever.
9. Code 09; Exit Device: Entrance by knob/lever with key (pullside) only. Unit is locked when the key is removed.
10. Code 10; Exit Device: Entrance by knob/lever. Inside key (pushside) locks/unlocks knob/lever. Outside key (pullside) only retracts latch.
11. Code 11; Exit Device: Entrance by auxiliary control turnpiece. Key (pullside) locks/unlocks auxiliary control.
12. Code 12 ; Exit Device: Entrance by auxiliary control turnpiece only when released by turning key (pullside). Unit is locked when the key is removed.

2.4 FINISHES

A. Finishes: Complying with BHMA A156.18.
1. Code 604: Zinc plated and dichromate sealed, with steel base material.
2. Code 626: Satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D).
3. Code 630: Satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D).
4. Code 652: Satin chromium plated over nickel, with steel base material (former US equivalent US26D).
5. Code 689: Aluminum painted, with any base material (former US equivalent US28).

PART 3 EXECUTION

3.1 DOOR HARDWARE SCHEDULE

A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated.

3.2 HARDWARE SET # 01: "SECURE ENTRY"

A. For use on Door Number(s): 000-1, 000-2, 014-1, 014-2, 028-1, 028-2.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
2 EA		CONTINUOUS HINGE	MCK-12HD PT/14HD PT AS REQ'D	CL	MK
1 EA		EXIT DEVICE	AD8413 106 ETL	US32D	SA
1 EA		EXIT DEVICE	AD8413 ETL	US32D	SA
2 EA		DOOR CLOSER	4040XP REG	689	LCN
2 EA		MOUNTING PLATE	4040	689	LCN
1 EA		ACTUATOR	8310-818T		LCN
2 EA		DOOR STOP	462	US32D	RO
1 EA		THRESHOLD	2005AT X OPENING WIDTH		PE
2 EA		SWEEP	345ANB X DOOR WIDTH		PE
2 EA		ASTRAGAL	305CN X DOOR HEIGHT		PE
2 EA		ELECTROLYNX HARNESS	QC-C X LENGTH REQ'D		MK
2 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
2 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
2 EA		POSITION SWITCH	DPS-M-BK		SU
1 EA		POWER SUPPLY	3520		SA

C. Door will have access control along with ADA push button for automatic open. Access control requirements to be coordinated with Owner's supplier. Rough-in for all access control components to be provided by Contractor..

D. Weatherstripping furnished by Aluminum Door Supplier. Card reader to be furnished by others.

3.3 HARDWARE SET # 02: "SECURE ENTRY"

A. For use on Door Number(s): 002-1, 002-2, 012-2, 017-2.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA		ENTRY LOCK	LC9453	626	SCH
1 EA		ELECTRIC STRIKE	1006	630	HS
1 EA		SMART PAC BRIDGE RECTIFIER	2005M3		HS
1 EA		ELECTRIC STRIKE FACEPLATE	HM	630	HS
1 EA		DOOR STOP	462	US32D	RO
1 EA		LATCH PROTECTOR	320	630	RO
1 EA		DOOR CLOSER	4040XP REG		LCN
1 EA		MOUNTING PLATE	4040		LCN
1 EA		ELECTROLYNX	QC-C X LENGTH REQ'D		MK

		HARNESS			
1 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
1 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
1 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		SWEEP	345ANB X DOOR WIDTH		PE
1 EA		WALL STOP	WS407CVX	630	IVE
1 EA		POWER SUPPLY	3520		SA

C. Door will have access control along with ADA push button for automatic open. Access control requirements to be coordinated with Owner's supplier. Rough-in for all access control components to be provided by Contractor..

D. Card reader to be furnished by others.

3.4 HARDWARE SET # 03: "OFFICE"

A. For use on Door Number(s): 005-1, 006-1, 006-2, 007-1, 008-1, 009-1, 010-1, 011-1, 012-1, 016-1, 054-1, 062-1, 062-2, 063-1, 064-1.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F17	MORTISE LOCK	L9050HD 17A L583-363	626	SCH
1 EA		PERMANENT CORE	OWNER SUPPLIED	626	BAS
1 EA		WALL STOP	WS407CVX	630	IVE
3 EA		SILENCER	SR64	GRY	IVE

3.5 HARDWARE SET # 04: "UNISEX RESTROOM"

A. For use on Door Number(s): 003-1, 004-1, 005-2, 015-1, 055-1.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F76	PRIVACY LOCK	L9040 17A L583-363	626	SCH
1 EA		WALL STOP	WS407CVX	630	IVE
3 EA		SILENCER	SR64	GRY	IVE

3.6 HARDWARE SET # 05: "RESTROOMS"

A. For use on Door Number(s): 020-1, 021-1, 030-1, 033-1, 037-1, 038-1, 042-1, 045-1, 049-1, 050-1.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA		PUSH PLATE	8200 4 X 16 INCH	630	IVE
1 EA		PULL PLATE	8303-8 3.5 X 15 INCH	630	IVE
1 EA		DOOR CLOSER	4040XP REG		LCN
1 EA		MOUNTING PLATE	4040		LCN
1 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		WALL STOP	WS407CVX	630	IVE
1 EA		FLOOR STOP	FS452	630	IVE
3 EA		SILENCER	SR64	GRY	IVE

C. Passage set, free entry and egress, self closing.

3.7 HARDWARE SET # 06: "STOREROOM"

A. For use on Door Number(s): 013-1,023-1, 026-1, 031-1, 032-1, 036-1, 039-1, 043-1, 044-1, 048-1, 051-1, 053-1, 057-1, 060-1.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F86	STOREROOM LOCK	L9080HD	626	SCH
1 EA		PERMANENT CORE	OWNER SUPPLIED	626	BAS
1 EA		DOOR CLOSER	4040XP REG		LCN
1 EA		MOUNTING PLATE	4040		LCN
1 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		WALL STOP	WS407CVX	630	IVE
3 EA		SILENCER	SR64	GRY	IVE

C. Door is locked at all times, retract latchbolt with a key and then door closes and relocks.

D. Where door is located within a rated wall provide **Zero, 188S-BK** gasketing around perimeter of door.

3.8 HARDWARE SET # 07: "MULTI-PURPOSE STOREROOM"

A. For use on Door Number(s): 019-1.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
6 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F86	STOREROOM LOCK	L9066HD	626	SCH
1 EA		PERMANENT CORE	OWNER SUPPLIED	626	BAS
1 EA		FLUSH BOLT	FB61P	630	IVE
2 EA		DOOR CLOSER	4040XP REG		LCN
2 EA		MOUNTING PLATE	4040		LCN
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
2 EA		WALL STOP	WS407CVX	630	IVE
6 EA		SILENCER	SR64	GRY	IVE

C. Door is locked at all times, retract latchbolt with a key and then door closes and relocks. Inactive leaf is activated once active leaf is opened and flush bolt retracts..

D. Where door is located within a rated wall provide **Zero, 188S-BK** gasketing around perimeter of door.

3.9 HARDWARE SET # 08: "ECSE RESTROOMS"

A. For use on Door Number(s): 024-1, 025-1, 025-2, 058-1, 059-1, 059-2.

B. Provide for each Single (SGL) Half door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
2 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F01	PASSAGE LOCK	L9010HD	626	SCH
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		WALL STOP	WS407CVX	630	IVE
1 EA		FLOOR STOP	FS452	630	IVE
2 EA		SILENCER	SR64	GRY	IVE

C. Passage set, free entry and egress.

3.10 HARDWARE SET # 09: "CLASSROOM"

A. For use on Door Number(s): 022-1, 027-1, 029-1, 034-1, 035-1, 040-1, 041-1, 046-1, 047-1, 052-1, 056-1, 061-1.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
6 EA		HINGE	5BB1 4.5 X 4.5	652	IVE
1 EA	F84	CLASSROOM LOCK	L9071HD 17A	626	SCH
1 EA		PERMANENT CORE	OWNER SUPPLIED	626	BAS
2 EA		DOOR CLOSER	4040XP REG		LCN
2 EA		MOUNTING PLATE	4040		LCN
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
2 EA		WALL STOP	WS407CVX	630	IVE
1 EA		FLOOR STOP	FS452	630	IVE
6 EA		SILENCER	SR64	GRY	IVE

3.11 HARDWARE SET # 10: "CORRIDOR"

A. For use on Door Number(s): 001-1.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
1 EA		CONTINUOUS HINGE	MCK-HG305	US32D	MK
1 EA		CONTINUOUS HINGE	MCK-HG305 EPT	US32D	MK
1 EA		EXIT DEVICE	FM8743 ETL	US32D	SAR
1 EA		EXIT DEVICE	FM8774 ETL	US32D	SAR
2 EA		CYLINDER	20-766	626	SCH
2 EA		SURFACE CLOSER	4040XP REG	689	LCN
2 EA		MOUNTING PLATE	4040	689	LCN
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
2 EA		MAG HOLD	SEM 7800	689	LCN
1 EA		ELECTROLYNX HARNESS	QC-C X LENGTH REQ'D		MK
1 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
1 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
1 EA		POWER SUPPLY	3520		SA

C. Doors will be held open at all times. At the time of an emergency, the doors will be released from hold opens and close.

3.12 HARDWARE SET # 11: "INTERIOR ICC 500"

A. For use on Door Number(s): 018-1.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
2 EA		CONTINUOUS HINGE	MCK-HG305	US32D	MK
2 EA		MULTIPOINT EXIT DEVICE	12 FM8743 ETL LC	US32D	SAR
1 EA		RIM CYLINDER	34	US32D	SAR
2 EA		SURFACE CLOSER	4040XP HD	689	LCN
2 EA		MOUNTING PLATE	4040	689	LCN

2 EA		MAG HOLD	SEM 7800	689	LCN
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
2 EA		GASKETING	188S-BK	GRY	ZER
2 EA		BRUSH ASTRAGAL	18041CNB X DOOR HEIGHT		PE
1 EA		ELECTROLYNX HARNESS	QC-C X LENGTH REQ'D		MK
1 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
1 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
1 EA		POWER SUPPLY	3520		SA

C. Doors will be held open at all times. At the time of an emergency, the doors will be released from hold opens and close.

3.13 HARDWARE SET # 12: "INTERIOR ICC 500"

A. [_____].

B. For use on Door Number(s): 017-1.

C. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
1 EA		CONTINUOUS HINGE	MCK-HG305	US32D	MK
1 EA		MULTIPOINT EXIT DEVICE	12 FM8743 ETL LC	US32D	SAR
1 EA		CYLINDER	20-766	US32D	SAR
1 EA		SURFACE CLOSER	4040XP HD	689	LCN
1 EA		MOUNTING PLATE	4040	689	LCN
1 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		GASKETING	188S-BK	GRY	ZER
1 EA		SOUND SEAL	S773D (HEAD & JAMB)		PE
1 EA		WALL STOP	WS407CVX	630	IVE

3.14 HARDWARE SET # 13: "EXTERIOR ICC 500"

A. For use on Door Number(s): 018-2, 018-3.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
2 EA		CONTINUOUS HINGE	MCK-HG305	US32D	MK
2 EA		MULTIPOINT EXIT DEVICE	12 FM8743 ETL LC	US32D	SAR
1 EA		RIM CYLINDER	34	US32D	SAR
2 EA		SURFACE CLOSER	4040XP HD	689	LCN
2 EA		MOUNTING PLATE	4040	689	LCN
1 EA		THRESHOLD	171A X OPENING WIDTH		PE
2 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
2 EA		FLOOR STOP	461	US26D	RO
1 EA		SOUND SEAL	S773D (HEAD & JAMB)		PE
1 EA		DRIP CAP	346C X FRAME WIDTH		PE
1 EA		DRIP SWEEP	345ANB X DOOR WIDTH		PE
2 EA		GASKETING	188S-BK	GRY	ZER
2 EA		BRUSH ASTRAGAL	18041CNB X DOOR HEIGHT		PE

1 EA		ELECTROLYNX HARNESS	QC-C X LENGTH REQ'D		MK
1 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
1 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
1 EA		POWER SUPPLY	3520		SA

C. Access control requirements to be coordinated with Owner's supplier. Rough-in for all access control components to be provided by Contractor..

3.15 HARDWARE SET # 14: "EXTERIOR ICC 500"

A. [_____].

B. For use on Door Number(s): 019-2.

C. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
1 EA		CONTINUOUS HINGE	MCK-HG305	US32D	MK
1 EA		MULTIPOINT EXIT DEVICE	12 FM8743 ETL LC	US32D	SAR
1 EA		RIM CYLINDER	34	US32D	SAR
1 EA		SURFACE CLOSER	4040XP HD	689	LCN
1 EA		MOUNTING PLATE	4040	689	LCN
1 EA		THRESHOLD	171A X OPENING WIDTH		PE
1 EA		KICKPLATE	8400 10" X 2" LDW	630	IVE
1 EA		FLOOR STOP	461	US26D	RO
1 EA		SOUND SEAL	S773D (HEAD & JAMB)		PE
1 EA		DRIP CAP	346C X FRAME WIDTH		PE
1 EA		DRIP SWEEP	345ANB X DOOR WIDTH		PE
1 EA		GASKETING	188S-BK	GRY	ZER
1 EA		ELECTROLYNX HARNESS	QC-C X LENGTH REQ'D		MK
1 EA		ELECTROLYNX HARNESS	QC-C1500P		MK
1 EA		ELECTRIC POWER TRANSFER	EL-CEPT		SU
1 EA		POWER SUPPLY	3520		SA

D. Access control requirements to be coordinated with Owner's supplier. Rough-in for all access control components to be provided by Contractor..

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Tornado-resistant hollow metal doors and frames.
E. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.
B. Section 088000 - Glazing: Glass for doors and borrowed lites.
C. Section 099113 - Exterior Painting: Field painting.
D. Section 099123 - Interior Painting: Field painting.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anhorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation
B. Coordinate requirements for installation of door hardware, electricified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.
B. ASCE: American Society of Civil Engineers.
C. HMMA: Hollow Metal Manufacturers Association.
D. NAAMM: National Association of Architectural Metal Manufacturers.
E. NFPA: National Fire Protection Association.
F. SDI: Steel Door Institute.
G. UL: Underwriters Laboratories.

1.6 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.
C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.
G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.

J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
K. FEMA P-361 - Safe Rooms for Tornadoes and Hurricanes: Guidance for Community and Residential Safe Rooms 2015.
L. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; National Storm Shelter Association 2014.
M. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
N. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
O. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
P. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.
Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
S. UL (DIR) - Online Certifications Directory Current Edition.
T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.7 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on the Drawings. Coordiante with final door hardware schedule.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project site storage. Do not use nonvented plastic.
    1. Provide additional protection to prevent damage to factory-finished units.
B. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
C. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.
D. Deliver welded frames with two removeable spreader bars across the bottom of frames, tack welded to jambs and mullions.
E. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
    2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
    3. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com.
    4. Mesker, dormakaba Group: www.meskeropeningsgroup.com/#sle.
    5. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
    6. Steelcraft, an Allegion brand: www.allegion.com/#sle.

B. Tornado-Resistant Hollow Metal Doors and Frames:
   1. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ATM E 136 for combustion characteristics.
F. Accessibility: Comply with ICC A117.1 and ADA Standards.
G. Fire-Rated Assemblies: Comply with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicted, based on testing at positive pressure according to NFPA 252 or UL 10C.
H. Door Edge Profile: Manufacturers standard for application indicated.
I. Typical Door Face Sheets: Flush.
J. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Mitered hairline joints.
   1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
K. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
L. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.
M. Construct hollow-metal doors and frames to comply with standards indictated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
N. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.
B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
      e. Zinc Coating: A 40 /ZF 120 galvannealed coating; ASTM A653/A653M.

2. Door Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density.
    a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate.
4. Door Thickness: 1-3/4 inch, nominal.
5. Top Closures: Flush with top of faces and edges.
6. Door Face Sheets: Flush.
7. Weatherstripping: Refer to Section 087100.
8. Door Type & Finish: As indicated in Door and Frame Schedule.

C. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inch, nominal.
4. Door Face Sheets: Flush.
5. Door Type & Finish: As indicated in Door and Frame Schedule.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR).
    a. Attach fire rating label to each fire rated unit.
4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
5. Door Thickness: 1-3/4 inch, nominal.
6. Door Face Sheets: Flush.
7. Door Type & Finish: As indicated in Door and Frame Schedule.

E. Tornado-Resistant Doors:
1. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
    a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
    b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval or UL (DIR) approval for Large and Small Missile impact and pressure cycling at design wind loads.
2. Tornado Shelter Application: Comply with ICC 500 standard.

a. Commercial: Designed and tested to comply with FEMA P-361 community shelter door assembly guidelines.

3. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
4. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
5. Door Thickness: 1-3/4 inch, nominal.
6. Door Face Sheets: Flush.
7. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished indicated in Drawings.

C. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   3. Weatherstripping: Separate, see Section 087100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

E. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

F. Tornado-Resistant Door Frames: With same tornado resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
   1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
   2. Frame Finish: Factory primed and field finished.

G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

H. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.

I. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

J. Transom Bars: Fixed, of profile same as jamb and head.

K. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

L. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.

2.5 FRAME ANCHORS

A. Frame Anchors: ASTM A879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet comply with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

B. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24-inches of frame height above 7-feet.
3. Post-installed Expansion Anchor: Minimum 3/8-inch diameter bolts with expansion shield or inserts, with manufacturer's standard pipe spacer.

C. Floor Anchors: Provide floor anchors for each jamb and mullion that extend to floor.

2.6 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.7 ACCESSORIES

A. Glazing: As specified in Section 088000, factory installed.
B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
C. Astragals for Double Doors: Specified in Section 08 7100.
D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restor exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
B. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
C. Drill and tap doors and frames to receive mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. Install doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install fire rated units in accordance with NFPA 80.
C. Coordinate frame anchor placement with wall construction.
D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
E. Install door hardware as specified in Section 087100.
F. Comply with glazing installation requirements of Section 088000.
G. Coordinate installation of electrical connections to electrical hardware items.
H. Touch up damaged factory finishes.

3.4 TOLERANCES

A. Hollow-Metal Frames:
1. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.
2. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

3. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
4. Plumbness: Plus or minus 1/16-inch, measured at jambs at floor.

B. Hollow-Metal Doors:
1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.5 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.6 CLEANING AND TOUCH-UP

A. 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.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush wood doors; flushand flush glazed configuration; fire-rated and non-rated.

1.2 RELATED REQUIREMENTS

A. Section 081113 - Hollow Metal Doors and Frames.
B. Section 087100 - Door Hardware.
C. Section 088000 - Glazing.

1.3 REFERENCE STANDARDS

A. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
B. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
C. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2013.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
D. Samples: For factory-finished veneers.
E. Warranty, executed in Owner's name.

1.5 CLOSEOUT SUBMITTALS

A. Owner's Manual and Maintenance Data.
B. Manufacturer's Warranty Form.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging, and inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.
D. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
    1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide product indicated in Drawings; or a comparable product by one of the following:
    1. Eggers Industries; <>
    2. Graham Wood Doors
    3. Marshfield DoorSystems, Inc; [____]
    4. VT Industries.
    5. OshKosh Door Company.

2.2 DOORS

A. Doors: See drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
1. Provide solid core doors at each location.
2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) labeledwithout any visible seals when door is closed.
3. Wood veneer facing with factory transparent finishas indicated on drawings.

2.3 DOOR CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.4 DOOR FACINGS

A. Veneer Facing for Transparent Finish: As indicated in Drawings, HPVA Grade A, plain sliced (flat cut), with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face; unless otherwise indicated.
1. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
2. Transoms: Continuous match to doors.

2.5 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.6 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
1. Transparent:
a. System - TR-6, Catalyzed Polyurethane.
b. Stain: As indicated on Drawings.
c. Sheen: Satin.
d. Grade: Premium.
e. Effect: Open-grain finish.

B. Factory finish doors in accordance with approved sample.

2.7 ACCESSORIES

A. Hollow Metal Door Frames: See Section 081113.

B. Glazing: See Section 088000.

C. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink styletamper proof screws.

D. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.
D. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and hav been installed with level heads and plumb jambs.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.
E. Coordinate installation of glazing.

3.3 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.
B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure.
C. Replace doors that are damaged or that do not comply with requirements. Doors may be repaired ar refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083313 - COILING COUNTER DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Storm shutter coiling counter doors and operating hardware.

B. Electric motor operation; wiring from electric circuit disconnect to operator to control station.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 260583 - Wiring Connections: Power to disconnect.

1.3 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators 2018.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.

C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.

D. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

E. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Coiling Counter Doors: Subject to compliance with requirements provide products by one of the following:

1. Alpine Overhead Doors, Inc: www.alpinedoors.com.
2. C.H.I. Overhead Doors: www.chiohd.com/sle.
3. Cornell Cookson, LLC.: www.cornelliron.com.

2.2 COILING COUNTER DOORS

A. Coiling Counter Doors, Storm Shutter: Steel slat curtain.

1. Mounting: Interior face mounted.
2. Nominal Slat Size: 4 inches wide.
3. Slat Profile: Flat.
4. Color: As selected by Architect from manufacturer's custom range.
5. Guides: Formed track; same material and finish unless otherwise indicated.
6. Hood Enclosure: Manufacturer's standard; galvanized steel color to match curtain.
7. Electric operation.
8. Locking Devices: Chain lock keeper on inside.

2.3 MATERIALS

A. Curtain Construction: Interlocking, single thickness slats.

1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.

B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.

C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

D. Lock Hardware:

1. Latchset Lock Cylinders: Standard mortise cylinder type; keyed differently.
   a. Keying: Differently.

2. For motor operated units, additional lock or latching mechanisms are not required.

E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.4 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Listed and classified by ITS (DIR) as suitable for purpose specified and indicated.
   1. Provide interlock switches on motor operated units.

B. Electric Operators:
   1. Mounting: Side mounted.
   2. Motor Enclosure: NEMA MG 1.
   3. Motor Rating: As recommended by manufacturer; continuous duty.
   4. Motor Voltage: Manufacturer's standard.
   5. Opening Speed: 6 inches per second.
   6. Manual override in case of power failure.

C. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each electrical operator.
   1. Controls: 24 VAC circuit.
   2. Surface mounted.

D. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 260583.

F. Complete wiring from disconnect to unit components.

G. Install perimeter trim as indicated.

3.3 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch.

C. Maximum Variation From Level: 1/16 inch.

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.4 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.
B. Aluminum doors and frames.
C. Weatherstripping.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 087100 - Door Hardware: Hardware items other than specified in this section.
C. Section 088000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.
B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.
J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
D. Samples: Submit two samples 12 by 12 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide 10 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

1. Failure include, but are not limited to, the following:
2. Structural failures, including but not limited to, excessive deflection.
3. Noise or vibration created by wind and thermal and structural movements
4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
5. Water penetration through fixed glazing and framing areas.
6. Failure of operating components.

C. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

1. 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.
    a. Deterioration includes, but is not limited to, the following:
        1) Color fading more than 5 Hunter units when tested according to ASTM D 2244.
        2) Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
        3) Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING - EXTERIOR

A. Center-Set Style, Thermally-Broken:

1. Basis of Design: Subject to compliance with requirements, provide EFCO Corporation; Series 403, Thermal Storefront Framing or a comparable product by one of the following:
    a. Kawneer North America; an Alcoa company.
    b. Manko Window Systems, Inc.
    c. Vistawall Architectural Products.

2.2 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING - INTERIOR

A. Center-Set Style:

1. Basis of Design: Subject to compliance with requirements, provide EFCO Corporation; Series 401, Non-Thermal Storefront Framing or a comparable product by one of the following:
    a. Kawneer North America; an Alcoa company.
    b. Manko Window Systems, Inc.
    c. Vistawall Architectural Products.

2.3 BASIS OF DESIGN -- SWINGING DOORS

A. Wide Stile, Monolithic Glazing:

1. Basis of Design: Subject to compliance with requirements, provide EFCO Corporation; Series D500 or a comparable product by one of the following:
    a. Kawneer North America; an Alcoa company.

b. Manko Window Systems, Inc.
c. Vistawall Architectural Products.

B. Wide Stile, Insulating Glazing, Thermally-Broken:
1. Basis of Design: Subject to compliance with requirements, provide EFCO Corporation; Series D502 Thermastile or a comparable product by one of the following:
a. Kawneer North America; an Alcoa company.
b. Manko Window Systems, Inc.
c. Vistawall Architectural Products.

2.4 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Finish: Class I color anodized.
a. Factory finish all surfaces that will be exposed in completed assemblies.
2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
5. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
6. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
8. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Design Wind Loads: Comply with requirements of ASCE 7.
b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 12 psf.
3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.5 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.

1. Glazing Stops: Flush.
2. Cross-Section: As indicated on drawings.

B. Glazing: As specified in Section 088000.

2.6 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.

D. Concealed Flashings: Stainless steel, 26 gage, 0.0187 inch minimum thickness.

E. Concealed Flashings: Sheet aluminum, 26 gage, 0.017 inch minimum thickness.

F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.

G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

H. Glazing Accessories: As specified in Section 088000.

2.7 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install glass and infill panels in accordance with Section 088000, using glazing method required to achieve performance criteria.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.5 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors.
B. Hardware for fire-rated doors.
C. Electrically operated and controlled hardware.
D. Thresholds.
E. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealants for setting exterior door thresholds.
B. Section 080671 - Door Hardware Schedule: Schedule of door hardware sets.
C. Section 081113 - Hollow Metal Doors and Frames.
D. Section 081116 - Aluminum Doors and Frames.
E. Section 081416 - Flush Wood Doors.
F. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
G. Section 084413 - Glazed Aluminum Curtain Walls: Door hardware, including cylinders.

1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. BHMA (CPD) - Certified Products Directory Current Edition.
C. BHMA A156.1 - American National Standard for Butts and Hinges 2016.
D. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches 2017.
E. BHMA A156.3 - American National Standard for Exit Devices 2014.
F. BHMA A156.4 - American National Standard for Door Controls - Closers 2013.
G. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks 2014.
H. BHMA A156.6 - American National Standard for Architectural Door Trim 2015.
I. BHMA A156.7 - American National Standard for Template Hinge Dimensions 2016.
J. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders 2015.
K. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000 2017.
L. BHMA A156.15 - American National Standard for Release Devices - Closer Holder, Electromagnetic and Electromechanical 2015.
M. BHMA A156.16 - American National Standard for Auxiliary Hardware 2018.
N. BHMA A156.18 - American National Standard for Materials and Finishes 2016.
O. BHMA A156.20 - American National Standard for Strap and Tee Hinges, and Hasps 2017.
P. BHMA A156.21 - American National Standard for Thresholds 2014.
Q. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems Sponsor 2017.
R. BHMA A156.23 - American National Standard for Electromagnetic Locks 2017.
S. BHMA A156.24 - American National Standard for Delayed Egress Locking Systems 2018.
T. BHMA A156.25 - American National Standard for Electrified Locking Devices 2018.
U. BHMA A156.26 - American National Standard for Continuous Hinges 2017.
V. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators 2013.
W. BHMA A156.36 - American National Standard for Auxiliary Locks 2016.
X. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
Y. BHMA A156.115W - American National Standard for Hardware Preparation in Wood Doors with Wood or Steel Frames 2006.

Z. DHI (H&S) - Sequence and Format for the Hardware Schedule 1996.
AA. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.
BB. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.
CC. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
DD. ITS (DIR) - Directory of Listed Products current edition.
EE. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
FF. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
GG. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
HH. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.
II. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
JJ. UL (DIR) - Online Certifications Directory Current Edition.
KK. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
    1. Hardware Installer.
D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
E. Keying Requirements Meeting:
    1. Schedule meeting at project site prior to Contractor occupancy.
    2. Attendance Required:
        a. Contractor.
        b. Owner.
        c. Architect.
        d. Hardware Installer.
        e. Owner's Security Consultant.
    3. Agenda:
        a. Establish keying requirements.
        b. Verify locksets and locking hardware are functionally correct for project requirements.
        c. Verify that keying and programming complies with project requirements.
        d. Establish keying submittal schedule and update requirements.
    4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
        a. Access control requirements.
        b. Key control system requirements.
        c. Schematic diagram of preliminary key system.
        d. Flow of traffic and extent of security required.
    5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

6. Deliver established keying requirements to manufacturers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
      a. Submit in vertical format, refer to Section 08 0671.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Include account of abbreviations and symbols used in schedule.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
   2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
   3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

F. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

I. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Lock Cylinders: Ten for each master keyed group.
   3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience and approved by manufacturer.

C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) to assist in work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Closers: Five years, minimum.
2. Exit Devices: Three years, minimum.
3. Locksets and Cylinders: Three years, minimum.
4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.
4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
6. Listed and certified compliant with specified standards by BHMA (CPD).
7. Auxiliary Hardware: BHMA A156.16.
8. Straps and Tee Hinges: BHMA A156.20.
9. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
10. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
11. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. Refer to Section 08 0671 for listing of hardware sets.

F. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
   a. Aluminum fasteners are not permitted.
   b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
   a. Self-drilling (Tek) type screws are not permitted.

3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction.
5. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
6. Fire-Rated Applications: Comply with NFPA 80.
    a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
    b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
7. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.2 HINGES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. McKinney; an Assa Abloy Group company; <>: www.assaabloydss.com.
2. Bommer Industries, Inc; <>: www.bommer.com.
3. C. R. Laurence Co., Inc; <>: www.crl-arch.com.
4. Hager Companies; <>: www.hagerco.com/#sle.
5. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
6. Ives; anAllegion brand; www.allegion.com/us.
7. Substitutions: See Section 016000 - Product Requirements.

B. Hinges: Comply with BHMA A156.1, Grade 1.
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
    a. Provide hinge width required to clear surrounding trim.
2. Continuous Hinges: Comply with BHMA A156.26.
3. Provide hinges on every swinging door.
4. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
5. Provide ball-bearing hinges at each door with closer.
6. Provide non-removable pins on exterior outswinging doors.
7. Provide non-removable pins on interior outswinging doors at locations as indicated.
8. Provide power transfer hinges where electrified hardware is mounted in door leaf.
9. Provide following quantity of butt hinges for each door:
    a. Doors up to 60 inches High: Two hinges.
    b. Doors From 60 inches High up to 90 inches High: Three hinges.
    c. Doors 90 inches High up to 120 inches High: Four hinges.
    d. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.
    e. Dutch Doors: Two hinges each leaf.

2.3 PIVOTS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. McKinney or Rixson; an Assa Abloy Group company; <>: www.assaabloydss.com.
2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
3. DORMA USA, Inc; LM Series: www.dorma.com/#sle.
4. Ives, an Allegion brand; <>: www.allegion.com/us.
5. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

B. Center-Hung and Offset Pivots: Comply with BHMA A156.4.

C. Door Weight: Medium; standard openings with up to 650 lbs door weight.

2.4 FLUSH BOLTS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Adams Rite, an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Hager Companies; <>: www.hagerco.com/#sle.
   3. Ives, an Allegion brand; <>: www.allegion.com/us.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
   1. Flush Bolt Throw: 3/4 inch, minimum.
   2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
      a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
   3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.

2.5 EXIT DEVICES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
   3. DORMA USA, Inc; 8000 Series: www.dorma.com/#sle.
   4. Hager Companies; <>: www.hagerco.com/#sle.
   5. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
   6. Von Duprin, an Allegion brand; <>: www.allegion.com/us.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. Provide cylinder with cylinder dogging or locking trim.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes.
   6. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
   7. For electrical options, provide quick connect plug-in pre-wired connectors.

2.6 ELECTRIC STRIKES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Adams Rite, HES, or Securitron; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Von Duprin; an Allegion brand; www.allegion.com/us..
   3. Substitutions: See Section 016000 - Product Requirements.

B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
   1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
   2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.
   3. Provide transformer and rectifier as necessary for complete installation.

4. Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.

2.7 ELECTROMAGNETIC LOCKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Securitron; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Schlage; an Allegion brand; www.allegion.com/us..
   3. Substitutions: See Section 016000 - Product Requirements.

B. Electromagnetic Locks: Comply with BHMA A156.23, Grade 1.
   1. Holding Force: 600 lbs, minimum.
   2. Voltage: 12 VDC, and provide power supplies by same manufacturer as locks.
   3. Provide electromagnetic locks for fire-rated doors in compliance with UL 10C.
   4. Mounting: Surface mounted to door and frame on secure side, with fasteners, brackets, and spacer bars as required for application.
   5. Provide concealed sensing device within device that monitors magnetic holding force to ensure appropriate door lock.

2.8 DELAYED-EGRESS ELECTROMAGNETIC LOCKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Securitron; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Von Duprin; an Allegion brand; www.allegion.com/us..
   3. Substitutions: See Section 016000 - Product Requirements.

B. Delayed-Egress Electromagnetic Locks: Comply with BHMA A156.24, Grade 1.
   1. Delayed-Egress Timer: Upon depressing push bar provide 15 seconds delay before door egress permitted, in compliance with NFPA 101.
   2. Holding Force: 600 lbs, minimum.
   3. Voltage: 12 VDC, and provide power supplies by same manufacturer as locks.
   4. Provide electromagnetic locks for fire-rated doors in compliance with UL 10C.
   5. Mounting: Surface mounted to door and frame on secure side, with fasteners, brackets, and spacer bars as required for application.

2.9 LOCK CYLINDERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Best, dormakaba Group; <>: www.bestaccess.com/#sle.
   2. Schlage; an Allegion brand; www.allegion.com/us..
   3. Yale; an Assa Abloy Group company; www.assaabloydss.com.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide standard, electronic, conventional, full size interchangeable core (FSIC), and small format interchangeable core (SFIC) type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
   2. Provide cylinders from same manufacturer as locking device.
   3. Provide cams and/or tailpieces as required for locking devices.

2.10 CYLINDRICAL LOCKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Schlage, an Allegion brand; <>: www.allegion.com/us.

3. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
1. Bored Hole: 2-1/8 inch diameter.
2. Latchbolt Throw: 1/2 inch, minimum.
3. Backset: 2-3/4 inch unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
a. Finish: To match lock or latch.
b. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
c. Aluminum-Frame Strike Box: Provide strike box fabricated for use with aluminum framing by framing manufacturer.
d. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.
5. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.11 MORTISE LOCKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Corbin Russwin, Sargent, or Yale; an Assa Abloy Group company; <>: www.assaabloydss.com.
2. Schlage, an Allegion brand; <>: www.allegion.com/us.
3. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
1. Latchbolt Throw: 3/4 inch, minimum.
2. Deadbolt Throw: 1 inch, minimum.
3. Backset: 2-3/4 inch unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
a. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
b. Aluminum-Frame Strike Box: Provide strike box fabricated for use with aluminum framing by framing manufacturer.
c. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.
d. Finish: To match lock or latch.

2.12 ELECTROMECHANICAL LOCKS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Sargent or Yale; an Assa Abloy Group company; <>: www.assaabloydss.com.
2. Schlage, an Allegion brand; <>: www.allegion.com/us.
3. Substitutions: See Section 016000 - Product Requirements.

B. Electromechanical Locks: Comply with BHMA A156.25, Grade 1.
1. Provide motor-driven or solenoid-driven locks, with strike that is applicable to frame.
2. Type: Mortise deadbolt.

2.13 AUXILIARY LOCKS (DEADLOCKS)

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Yale; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.

2. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
3. [Schlage, an Allegion brand; <> : www.allegion.com/us.].
4. Substitutions: See Section 016000 - Product Requirements.

B. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
1. Type: Bored (cylindrical).
2. Application: Bored.
3. Backset: 2-3/4 inch, unless otherwise indicated.
4. Bolt Throw: 1/2 inch, with latch made of hardened steel.
5. Provide strike that matches frame.

2.14 DOOR PULLS AND PUSH PLATES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
2. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>: www.activarcpg.com/hiawatha/#sle.
3. Trimco; <>: www.trimcohardware.com/#sle.
4. [Ives, an Allegion brand; <> : www.allegion.com/us.].
5. Substitutions: See Section 016000 - Product Requirements.

B. Door Pulls and Push Plates: Comply with BHMA A156.6.
1. Pull Type: Straight, unless otherwise indicated.
2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
a. Edges: Beveled, unless otherwise indicated.
3. Material: Aluminum, unless otherwise indicated.
4. On solid doors, provide matching door pull and push plate on opposite faces.
5. On glazed storefront doors, provide matching door pulls/push plates on both faces unless otherwise indicated.

2.15 DOOR PULLS AND PUSH BARS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com.
2. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>: www.activarcpg.com/hiawatha.
3. Trimco; <>: www.trimcohardware.com.
4. [Ives, an Allegion brand; <> : www.allegion.com/us.].
5. Substitutions: See Section 016000 - Product Requirements.

B. Door Pulls and Push Bars: Comply with BHMA A156.6.
1. Bar Type: Bar set, unless otherwise indicated.
2. Material: Aluminum, unless otherwise indicated.

2.16 COORDINATORS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
2. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>: www.activarcpg.com/hiawatha/#sle.
3. Ives, an Allegion brand; <>: www.allegion.com/us/#sle.
4. Trimco; <>: www.trimcohardware.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

B. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.

1. Type: Bar, unless otherwise indicated.
2. Material: Aluminum, unless otherwise indicated.
3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.17 CLOSERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following: Surface Mounted:
   1. Corbin Russwin, Norton, Rixson, Sargent, or Yale; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
   3. LCN, an Allegion brand; <>: www.allegion.com/us.
   4. Stanley, dormakaba Group; <>: www.stanleyhardwarefordoors.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Closers: Comply with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.
   3. Provide door closer on each fire-rated and smoke-rated door.
      a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
   4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
   5. At corridor entry doors, mount closer on room side of door.
   6. At outswinging exterior doors, mount closer on interior side of door.

2.18 OVERHEAD STOPS AND HOLDERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Rixson or Sargent; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
   3. Glynn-Johnson, an Allegion brand; <>: www.allegion.com/us.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
   1. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.

2.19 PROTECTION PLATES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
   3. Hiawatha, Inc, an Activar Construction Products Group company; <>: www.activarcpg.com/hiawatha.
   4. Ives, an Allegion brand; <>: www.allegion.com/us.
   5. Trimco; <>: www.trimcohardware.com.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Protection Plates: Comply with BHMA A156.6.

C. Metal Properties: Aluminum.
   1. Metal, Standard Duty: Thickness 0.05 inch, minimum.

D. Edges: Square, on four sides unless otherwise indicated.

E. Fasteners: Countersunk screw fasteners.

F. Drip Guard: Provide at head of exterior doors unless covered by roof or canopy.

2.20 ARMOR PLATES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Hiawatha, Inc, an Activar Construction Products Group company; <>: www.activarcpg.com/hiawatha.
   2. Ives, an Allegion brand; <>: www.allegion.com/us.
   3. Trimco; <>: www.trimcohardware.com.
   4. [Rockwood; an Assa Abloy Group company; <> : www.assaabloydss.com.].
   5. Substitutions: See Section 016000 - Product Requirements.

B. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface.
   1. Size: 16 inch high by 1-1/2 inch less door width (LDW) on pull side and 2 inch LDW on push side of door.

2.21 KICK PLATES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Hiawatha, Inc, an Activar Construction Products Group company; <>:
   2. Ives, an Allegion brand; <>: www.allegion.com/us/#sle.
   3. Trimco; <>: www.trimcohardware.com/#sle.
   4. [Rockwood; an Assa Abloy Group company; <> : www.assaabloydss.com.].
   5. Substitutions: See Section 016000 - Product Requirements.

B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
   1. Size: 8 inch high by 2 inch less door width (LDW) on push side of door.

2.22 DOOR HOLDERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. McKinney or Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. C. R. Laurence Company, Inc; <>: www.crl-arch.com.
   3. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>: www.activarcpg.com/hiawatha.
   4. Trimco; <>: www.trimcohardware.com.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Door Holders: Comply with BHMA A156.16, Grade 1.
   1. Type: Lever, or kick down stop, with rubber bumper at bottom end.
   2. Material: Aluminum.

2.23 ELECTROMAGNETIC DOOR HOLDERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Rixson or Sargent; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
   2. LCN; an Allegion brand;.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Electromagnetic Door Holders: Comply with BHMA A156.15.
   1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
   2. Holding Force, Standard Duty: 40 lbs-force, minimum.
   3. Voltage: 12 VDC, and provide power supplies by same manufacturer as holders.
   4. Fail safe; door released to close automatically when electrical current is interrupted.
   5. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

2.24 FLOOR STOPS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>: www.activarcpg.com/hiawatha.
   3. Trimco; <>: www.trimcohardware.com.
   4. Ives; an Allegion brand;.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
   2. Type: Manual hold-open, with pencil floor stop.
   3. Material: Aluminum housing with rubber insert.

2.25 WALL STOPS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
   2. Hiawatha, Inc, division of Activar Construction Products Group, Inc; <>:
   3. Trimco; <>: www.trimcohardware.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide wall stops to prevent damage to wall surface upon opening door.
   2. Type: Bumper, concave, wall stop.
   3. Material: Aluminum housing with rubber insert.

2.26 ASTRAGALS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Pemko; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
   2. Zero International, Inc; <>: www.zerointernational.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Astragals: Comply with BHMA A156.22.
   1. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
   2. Type: Split, two parts, and with sealing gasket.
   3. Material: Aluminum, with neoprene weatherstripping.
   4. Provide non-corroding fasteners at exterior locations.

2.27 THRESHOLDS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Pemko; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
   2. Zero International, Inc; <>: www.zerointernational.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Thresholds: Comply with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.
   2. Type: Flat surface.
   3. Material: Aluminum.

4. Threshold Surface: Fluted horizontal grooves across full width.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

2.28 WEATHERSTRIPPING AND GASKETING

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Pemko; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Zero International, Inc: www.zerointernational.com.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Door Sweep Type: Encased in retainer.
   2. Provide gasketing for smoke and draft control doors that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
   3. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
   4. Provide door bottom sweep on each exterior door, unless otherwise indicated.
   5. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

2.29 SILENCERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Ives, an Allegion brand; <><>: www.allegion.com/us/#sle.
   2. Rockwood; an Assa Abloy Group company; <>: www.assaabloydss.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
   3. Material: Rubber, gray color.

2.30 VIEWER

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Ives, an Allegion brand; <>: www.allegion.com/us/#sle.
   2. Rockwood; an Assa Abloy Group company; .
   3. Substitutions: See Section 016000 - Product Requirements.

B. Viewer: Provide at inside of door at eye level to see who is on outside of door.
   1. Material: Aluminum.

2.31 FIRE DEPARTMENT LOCK BOX

A. Fire Department Lock Box:
   1. Heavy-duty, surface mounted, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
   2. Capacity: Holds2 keys.
   3. Finish: Manufacturer's standard dark bronze.

2.32 EXIT MOTION SENSOR

A. Manufacturers:
   1. Securitron; an Assa Abloy Group company; [_____]: www.assaabloydss.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Exit Motion Sensor: Interior passive infrared detection device to initiate door release of exit door magnetic lock.
   1. Power: 12 VDC.
   2. Provide adjustable detector face to allow for precise pattern configurations, and easy pattern adjustment.
   3. Provide relay that operates before transistor to prevent false alarms.
   4. Operating Temperature: 32 to 110 degrees F.

2.33 KEY PAD

A. Manufacturers:
   1. Securitron; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Substitutions: See Section 016000 - Product Requirements.
B. Key Pad: Indoor or outdoor use, 12-key digital keypad with silicone rubber keys, and compatible with access control systems using standard Wiegand output.
   1. Power: 12 VDC; 35mA Active and 7mA at Rest.
   2. Mounts on narrow mullion, 1-1/2 inch wide by 7 inch high by 1 inch deep.
   3. Operating Temperature: Minus 22 to 158 degrees F.
   4. Finish: Black.

2.34 POWER SUPPLY

A. Manufacturers:
   1. Securitron; an Assa Abloy Group company; <>: www.assaabloydss.com.
   2. Substitutions: See Section 016000 - Product Requirements.
B. Power Supply: Hard wired, with multiple zones providing eight (8) breakers for each output panel with individual control switches and LED's; UL (DIR) Class 2 listed.
   1. Power: 24 VAC, 10 Amp; with 120 VAC power supply.
   2. Operating Temperature: 32 to 110 degrees F.
   3. Provide with emergency release terminals that release devices upon activation of fire alarm system.

2.35 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
   2. Exceptions:
      a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
      b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.
      c. Door Closer Covers and Arms: Color as selected by Architect from manufacturer's standard colors unless otherwise indicated.
      d. Aluminum Surface Trim and Gasket Housings: Anodized to match door panel finish, not other hardware, unless otherwise indicated.
      e. Hardware for Aluminum Storefront Doors: Finished to match door panel finish, except at hand contact surfaces provide stainless steel with satin finish, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
B. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.
B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
D. Use templates provided by hardware item manufacturer.
E. Do not install surface mounted items until application of finishes to substrate are fully completed.
F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
    1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
    2. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
    3. Mounting heights in compliance with ADA Standards:
        a. Locksets: 40-5/16 inch.
        b. Push Plates/Pull Bars: 42 inch.
        c. Deadlocks (Deadbolts): 48 inch.
        d. Exit Devices: 40-5/16 inch.
        e. Door Viewer: 43 inch; standard height 60 inch.
G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.
B. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
B. Clean adjacent surfaces soiled by hardware installation.
C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.5 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 088000 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.
B. Glazing units.
C. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.
C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2015).
D. ASTM C1036 - Standard Specification for Flat Glass 2016.
E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021.
H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
J. GANA (SM) - GANA Sealant Manual 2008.
K. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
L. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).
M. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting a minimum 5 business days before starting work of this section; require attendance by each of the affected installers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit 1 sample 12 inch by 12 inch in sizeof glass units.
E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience and approved by manufacturer.
C. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a ten (10) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:

A. Glass Fabricators:

1. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
3. Guardian Glass, LLC: www.guardinaglass.com.
4. Oldcastle Building Envelope: www.obe.com.
5. Pilkington North Ameria, Inc; www.pilkington.com
6. Vitro Architectural Glass: www.vitroglazings.com

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure: Calculated in accordance with applicable codes and as indicated on Drawings.
2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
5. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.

1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT, Condition A, (uncoated) unless
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
   5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
   1. Cardinal Glass Industries; <>: www.cardinalcorp.com/#sle.
   2. Guardian Glass, LLC; <>: www.guardianglass.com/#sle.
   3. Pilkington North America Inc; <>: www.pilkington.com/na/#sle.Pilkington North America Inc; <>: www.pilkington.com/na/#sle.
   4. Vitro Architectural Glass (formerly PPG Glass); <>: www.vitroglazings.com/#sle.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Perimeter Spacers: Manufacturer's standard space material and construction.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us.
         2) Thermix; a brand of Ensigner USA; Thermix: www.thermix.de.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide manufacturer's standard primary and secondary sealsants.
   6. Color: Black.
   7. Purge interpane space with dry air, hermetically sealed.

2.5 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Basis of Design - Insulating Glass Units: Vision glazing, with Low-E coating.
   1. Applications: Exterior insulating glass glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Total Thickness: 1 inch.
   4. Thermal Transmittance (U-Value), Summer - Center of Glass: [_____], nominal.
   5. Visible Light Transmittance (VLT): [_____] percent, nominal.
   6. Shading Coefficient: [_____], nominal.
   7. Solar Heat Gain Coefficient (SHGC): [_____], nominal.
   8. Visible Light Reflectance, Outside: [_____] percent, nominal.
   9. Glazing Method: Dry glazing method, gasket glazing.
   10. Spacer Color: Black.
   11. Edge Seal:
      a. Single-Sealed System: Provide silicone sealant as seal applied around perimeter.
   12. Color: Black.

13. Purge interpane space with dry air, hermetically sealed.
14. Basis of Design - Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
15. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
    a. Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 60 on #3 surface.
    b. Glass Tint: Solargray (light-gray).
    c. Tint: Greylite II.
16. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
    a. Glass: Starphire (Ultra Clear).

2.6 GLAZING UNIT SCHEDULE

A. Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Heat-strengthened float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.
5. Safety Glazing as indicated on Drawings.

2.7 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 100/50, Use NT ; with cured Shore A hardness range of 15 to 25; color as selected by Architect from manufacturer's full range.

B. Manufacturers:
1. BASF Corporation; <>: www.basf.com/us/en.html/#sle.
2. Dow Corning Corporation; 790 Silicone Building Sealant: www.dowcorning.com/construction.
3. Momentive Performance Materials, Inc; SCS2700 SilPruf LM: www.momentive.com.
4. Pecora Corporation; 890NST: www.pecora.com.
5. Sika Corporation; SikaSil WS-290: www.sika.com.
6. Tremco Commercial Sealants & Waterproofing; Spectrum 1: www.tremcosealants.com.

2.8 ACCESSORIES

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of 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. Glazing Tape: Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

G. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

H. Glazing Clips: Manufacturer's standard type.

I. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.

D. Fill gaps between glazing and stops with [_____] type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.

E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.6 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.7 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 088719 - SECURITY GLAZING FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glazing film applied to existing and new glazing assemblies.

1.2 REFERENCE STANDARDS

A. WEY-SA-C1 - Standard for shooter/attack certification and forced entry.

B. GSA Level C - General Services Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.

C. EN356 P4 - Testing and Classification of Resistance Against Manual Attack.

D. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

E. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.

F. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

H. ASTM F1642/F1642M - Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings 2017.

I. UL 972 - Standard for Burglary Resisting Glazing Material Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Record of product certifications for safety requirements.
2. Preparation instrucitons and reccomendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

C. Product Samples For each film product to be used provide one sample a minimum of 4 inches by 4 inches representing actual product, color, and pattern.

1.4 CLOSEOUT SUBMITTALS

A. Warranty form filled out in Owner's name.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's un-opened packaging until ready for installation.

B. Store and dispose of solvent-based materials and materials used with solvent-based materials in accordance with requirements of authoritis having jurisdiction.

1.6 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limites reccomended by manufacturer for optimal results. Do no install products under environmental conditions outside of manufacturer's absolute limits.

1.7 WARRANTY

A. Provide 12 year manufacturer's replacement warranty covering film against peerling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.1 Clear microlayered safety and security window film

A. Film to be applied at the back (on the interior side / opposite of attack face) side of glazing.

1. Basis-of-Design: 3M Scotchshield Ultra S800 Safety and Security Film. Optically clear microlayered polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive on the other. The adhesive is pressure-

activated, not water-activated, and forms a physical bond, not chemical bond, to the glass. The film is microlayered with both plastic and ductile polyester layers for tear resistance.

a. Glazing Film: Transparent polyster film for permanent bonding to glass.
b. Thickness: 0.008 inches (8 mils) minimum.
c. Color: Clear
d. Visible Light Transmittance: 87 percent when film is applied to 1/4 thick clear annealed glass.

2.2 Attachment system method

A. Impact Protection Adhesive (IPA).
1. Thickness: 0.008 inches (8 mils) minimum using a single layer film. Multi-layered film to achieve thickness is not permitted.
2. Color: Clear.
3. Construciton: 3-ply laminate.
4. Adhesive Type: Pressure sensative.
5. Tensile Strength: 28,500 psi minimum.
6. Breaking Strength: 615 lbs/inch minimum.
7. Elongation at Break 230% maximum.
8. Surface Burning Characteristics: Flame spread index of 25 minimum and smoke developed index of 450 maximum when tested in accordance with ASTM E84 (Class A).
9. Visible Light Transmittance: 87 percent when film is applied to 1/4 thick clear annealed glass.
10. Anchoring System: DOW 995 or GE SCS2000 SilPruf Structural Sealant with high impact styrene trim.

PART 3 EXECUTION

3.1 INSTALLERS

A. Utilize installers trained and certified by film manufacturer in the application of the product.

3.2 EXAMINATION

A. Field-Applied Film: Verify that the existing conditions are adequate for the proper application and performance of film.
B. Verify that the glass is not cracked, chipped, broken, or damaged before installation.
C. Verify that frames are securely anchored and free from defects before installation.

3.3 PREPARATION

A. Clean glass to remove dust, dirt, paint, oil, grease, mildew, mold, or any other contaminants that ould inhibit adhesion.
B. Immediately prior to applying film, thoroughly wash glass with a neutral cleaning solution.
C. Protext adjacent surfaces.
D. Do not being installation of film until substrates have been properly prepared.

3.4 INSTALLATION

A. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps as required to achieve specified performance.
B. Accurately cut film with straight edges to required sizes alowing between a 1/16" to 1/8 gap at perimeter of glazed panel unless other required by anchorage method.
C. Provide seamless installation unless limited by manufacturing. Do not provide overlapped installation.
D. Clean glass and excess structural sealants from finished surfaces.
E. Remove any labels or protective covers.

3.5 PROTECTION

A. Protect installed products until completion of the project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 090561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.
   3. Thin-set ceramic tile and stone tile.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Remedial floor coatings.

1.2 RELATED REQUIREMENTS

A. Section 012200 - Unit Prices: Bid pricing for remediation treatments if required.

B. Section 012300 - Alternates: Bid pricing for remediation treatments if required.

C. Section 033000 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

D. Section 033000 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.

E. Section 033000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.3 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2020b.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Adhesive Bond and Compatibility Test Report.

C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's statement of compatibility with types of flooring applied over remedial product.

2. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.6 QUALITY ASSURANCE

A. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.

B. Deliver materials in manufacturer's packaging; include installation instructions.

C. Keep materials from freezing.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:

1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
2. Products:
   a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
   b. LATICRETE International, Inc; LATICRETE NXT Vapor Reduction Coating with LATICRETE NXT Level Plus: www.laticrete.com/#sle.
   c. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
   d. TEC, an H.B. Fuller Construction Products Brand; TEC LiquiDam EZ with TEC Level Set 200 SLU: www.tecspecialty.com/#sle.
   e. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle.
   f. Spray Lock SCP327.
   g. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:

1. Preliminary cleaning.
2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring

manufacturer.

3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Specified remediation, if required.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

B. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.4 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.

C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine

alkalinity (pH) reading.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.5 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.6 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.7 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.8 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Gypsum wallboard.
F. Joint treatment and accessories.
G. Textured finish system.

1.2 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.
B. Section 061000 - Rough Carpentry: Building framing and sheathing.
C. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
D. Section 078400 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
E. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.3 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.
E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
F. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board 2004 (Reapproved 2020).
G. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
H. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.
L. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
M. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2019.
N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
O. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
P. ASTM E413 - Classification for Rating Sound Insulation 2016.
Q. GA-216 - Application and Finishing of Gypsum Panel Products 2016.
R. GA-600 - Fire Resistance Design Manual 2015.

1.4 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.
B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Partitions: UL listed assembly as indicated on Drawings.
   2. Fire Rated Shaft Walls: UL listed assembly as indicated on Drawings.
D. STC-Rated Assemblies: Provide complete assemblies identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by and independent agency.

2.2 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich; <>: www.clarkdietrich.com/#sle.
   2. Jaimes Industries; <>: www.jaimesind.com/#sle.
   3. Marino; <>: www.marinoware.com/#sle.
   4. R-stud, LLC; <>: www.rstud.com/#sle.
   5. Phillips Manufacturing Co; <>: www.phillipsmfg.com/#sle.
   6. SCAFCO Corporation; <>: www.scafco.com/#sle.
   7. Steel Construction Systems; <>: www.steelconsystems.com/#sle.
   8. Substitutions: See Section 016000 - Product Requirements.
B. Structural Steel Framing for Application of Gypsum Board: As specified in Section 054000.
C. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 7.5 psf.
   1. Studs: "C" shaped with knurled or emobossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
      a. Products:
         1) Same manufacturer as other framing materials.
         2) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
         3) Phillips Manufacturing Co; RC-2 Resilient Sound Channel: www.phillipsmfg.com/#sle.
         4) Substitutions: See Section 016000 - Product Requirements.
D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.

2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
    a. Products:
        1) FireTrak Corporation; Posi Klip.
        2) Metal-Lite, Inc; The System.
        3) Substitutions: See Section 016000 - Product Requirements.
5. Deflection and Firestop Track:
6. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

E. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
    a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
    b. Height: 35-3/4 inches.
    c. Products:
        1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
        2) Substitutions: See Section 016000 - Product Requirements.
3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
    a. Products:
        1) ClarkDietrich; FastBridge Clip (FB33): www.clarkdietrich.com/#sle.
4. Flexible Wood Backing: Fire-retardant-treated wood with sheet steel connectors.
    a. Products:
        1) ClarkDietrich; Danback: www.clarkdietrich.com/#sle.
        2) Substitutions: See Section 016000 - Product Requirements.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum Company; <>: www.americangypsum.com/#sle.
2. CertainTeed Corporation; <>: www.certainteed.com/#sle.
3. Continental Building Products; <>: www.continental-bp.com/#sle.
4. Georgia-Pacific Gypsum; <>: www.gpgypsum.com/#sle.
5. National Gypsum Company; <>: www.nationalgypsum.com/#sle.
6. PABCO Gypsum; <>: www.pabcogypsum.com/#sle.
7. USG Corporation; <>: www.usg.com/#sle.
8. Substitutions: See Section 016000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
3. Thickness:
    a. Vertical Surfaces: 5/8 inch.

b. Ceilings: 5/8 inch.
c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

4. Paper-Faced Products:
   a. American Gypsum Company; FireBloc Type X Gypsum Wallboard.
   b. CertainTeed Corporation; Type X Drywall.
   c. Continental Building Products; Firecheck Type X.
   d. Georgia-Pacific Gypsum; ToughRock Fireguard X.
   e. Substitutions: See Section 016000 - Product Requirements.
5. Mold Resistant Paper Faced Products:
   a. American Gypsum Company; M-Bloc Type X.
   b. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall.
   c. Continental Building Products; Mold Defense Type X.
   d. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard.
   e. National Gypsum Company; Gold Bond XP Gypsum Board.
   f. Substitutions: See Section 016000 - Product Requirements.

C. Abuse Resistant Wallboard:
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
7. Type: Fire-resistance-rated Type X, UL or WH listed.
8. Thickness: 5/8 inch.
9. Edges: Tapered.
10. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc AR Type X.
    b. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech.
    c. Continental Building Products; Protecta AR 100 Type X with Mold Defense.
    d. Continental Building Products; Rapid Deco Level 5 Type X with Protecta.
    e. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant.
    f. National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.
    g. Substitutions: See Section 016000 - Product Requirements.

D. Impact Resistant Wallboard:
1. Application: High-traffic areas indicated.
2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
7. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
8. Type: Fire-resistance-rated Type X, UL or WH listed.
9. Thickness: 5/8 inch.
10. Edges: Tapered.

11. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc IR Type X.
    b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech.
    c. Continental Building Products; Protecta HIR 300 Type X with Mold Defense.
    d. National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
    e. Substitutions: See Section 016000 - Product Requirements.

E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
2. Thickness: 1/2 inch.
3. Edges: Tapered.
4. Products:
    a. CertainTeed Corporation; Interior Ceiling Drywall.
    b. Continental Building Products; Sagcheck.
    c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
    d. Substitutions: See Section 016000 - Product Requirements.

F. Exterior Sheathing Board: As specified in Section 061000.

2.4 Gypsum Wallboard ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 4 inch.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
1. Products:
    a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/#sle.
    b. Liquid Nails, a brand of PPG Architectural Coatings; AS-825 Acoustical Sound Sealant: www.liquidnails.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.

C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead, L-bead, and LC-bead at exposed panel edges.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Joint Compound: Drying type, vinyl-based, ready-mixed.
    a. Products:
        1) CertainTeed Corporation; Extreme All-Purpose Joint Compound: www.certainteed.com/#sle.
        2) Continental Building Products; <>: www.continental-bp.com/#sle.
        3) Substitutions: See Section 016000 - Product Requirements.

E. Finishing Compound: Surface coat and primer, takes the place of skim coating.
1. Products:
    a. CertainTeed Corporation; Quick Prep Plus Interior Prep Coat: www.certainteed.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

F. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

1. Products:
    a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfacer with M2Tech: www.certainteed.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

G. Textured Finish Materials: Latex-based compound; plain.
1. Products:
    a. CertainTeed Corporation; Extreme Texture Coat/Acrylic Texture with M2Tech: www.certainteed.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.

H. Nails for Attachment to Wood Members: ASTM C514.

I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.
3. Install bracing as required at exterior locations to resist wind uplift.

C. Studs: Space studs at 16 inches on center.
1. Extend partition framing as indicated in Drawings.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
1. Orientation: Horizontal.
2. Spacing: As indicated.

F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.

G. Blocking: Install wood blocking for support of:
1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

1. Place one bead continuously on substrate before installation of perimeter framing members.
2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

E. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
1. Single-Layer Applications: Screw attachment.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
3. Level 3: Walls to receive textured wall finish.
4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
6. Level 0: Temporary partitions.
7. Level 0: Surfaces indicated to be finished in later stage of project.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.
2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
3. Taping, filling, and sanding are not required at base layer of double-layer applications.

D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.7 TEXTURE FINISH

A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.8 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.
B. Framing accessories.

1.2 RELATED REQUIREMENTS

A. Section 076200 - Sheet Metal Flashing and Trim: Head and sill flashings
B. Section 078400 - Firestopping: Sealing top-of-wall assemblies at fire rated walls.
C. Section 079200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
D. Section 092116 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.
E. Section 092116 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.
F. Section 313116 - Termite Control: Field-applied termiticide and mildewcide for metal framing.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories: Subject to compliance with requirements, provide products by one of the following:
   1. CEMCO: www.cemcosteel.com.
   2. ClarkDietrich Building Systems: www.clarkdietrich.com.
   3. The Steel Network, Inc: www.SteelNetwork.com.
   4. MBA Building Supplies: www.mbastuds.com.
   5. MRI Steel Framing: www.mristeelframing.com.
   6. Phillips Manufacturing Co.: www.phillipsmfg.com.
   7. Telling Industries: www.buildstrong.com.
   8. Substitutions: See Section 016000 - Product Requirements.

2.2 FRAMING MATERIALS

A. Fire Rated Assemblies: Comply with applicable code and tested in accordance with ASTM E 119 by an independent testing agency.
B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing as indicated on Drawings.
   1. Studs: C shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
C. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing

rotation of studs while maintaining structural performance of partition.

D. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

2.3 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.2 INSTALLATION OF STUD FRAMING

A. Extend partition framing to structure where indicated and to ceiling in other locations.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Align and secure top and bottom runners at 24 inches on center.

D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

E. Install studs vertically at spacing indicated on drawings.

F. Align stud web openings horizontally.

G. Secure studs to tracks using fastener method. Do not weld.

H. Stud splicing is not permissible.

I. Fabricate corners using a minimum of three studs.

J. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.

K. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

L. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

M. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

SECTION 093000 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tile for floor applications.
B. Tile for wall applications.
C. Cementitious backer board as tile substrate.
D. Ceramic trim.
E. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement 1999 (Reaffirmed 2016).
E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2009 (Revised).
F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2010).
H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2010).
I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2010).
J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2016).
N. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
O. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
P. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 1999 (Reaffirmed 2016).

Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.
R. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014.
S. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2019.
T. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).
U. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
C. Samples: Mount tile and apply grout on two plywood panels, minimum 36 by 36 inches in size illustrating pattern, color variations, and grout joint size variations.
D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Tile: 10 square feet of each size, color, and surface finish combination.
    3. 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.

1.6 QUALITY ASSURANCE

A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
C. Installer Qualifications:
    1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.7 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
    1. Minimum size of mock-up is indicated on drawings. Mock ups to include wall and floor tile.
    2. Approved mock-up may remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.1 TILE

A. Manufacturers: [_____]
    1. American Olean Corporation: www.americanolean.com/#sle.

2. Dal-Tile Corporation: www.daltile.com/#sle.
3. Emser Tile, LLC: www.emser.com/#sle.
4. Terrazzo & Marble Supply Companies: www.tmsupply.com/#sle.
5. Fiandre Architectural Surfaces www.granitifiandre.com
6. Landmark Ceramics www.landmarkceramics.com
7. Substitutions: See Section 016000 - Product Requirements.

B. Ceramic Tile: ANSI A137.1 standard grade.
1. Size: As indicated on Drawings.
2. Color(s): As indicated on Drawings.
3. Pattern: As indicated on Drawings.
4. Products: As indicated on Drawings.

2.2 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
1. Applications:
a. Open Edges: Bullnose.
b. Inside Corners: Jointed.
c. Floor to Wall Joints: Cove base.
2. Manufacturers: Same as for tile.

B. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
a. Open edges of wall tile.
b. Open edges of floor tile.
c. Wall corners, outside and inside.
d. Transition between floor finishes of different heights.
e. Floor to wall joints.
f. Borders and other trim as indicated on drawings.
2. Manufacturers:
a. Schluter-Systems: www.schluter.com/#sle.
b. Genesis APS International: www.genesis-aps.com/#sle.

2.3 SETTING MATERIALS

A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
2. Products:
a. ARDEX Engineered Cements; ARDEX N 23 MICROTEC: www.ardexamericas.com/#sle.
b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
c. TEC, an H.B. Fuller Construction Products Brand; TEC Ultimate Large Tile Mortar: www.tecspecialty.com/#sle.

2.4 GROUTS

A. Standard Grout: ANSI A118.6 standard cement grout.
1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.

3. Color(s): As indicated on drawings.
4. Products: Subject to compliance with requirements provide products by one of the following:
    a. Custom Building Products; Polyblend Non-Sanded Grout: www.custombuildingproducts.com/#sle.
    b. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
    c. Mapei Corporation www.mapei.com

B. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
1. Applications: all grout applications.

2.5 Maintenance Materials

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
1. Applications: Between tile and plumbing fixtures.
2. Color(s): As selected by Architect from manufacturer's full line.
3. Products: Subject to compliance with requirements, provide products by one of the following:
    a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
    b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
    c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.
2. Products: Subject to compliance with requirements, provide products by one of the following:
    a. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com/#sle.

2.6 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Crack Resistance: No failure at 1/8 inch gap, minimum.
2. Fluid or Trowel Applied Type:
    a. Material: Synthetic rubber, Synthetic rubber, Acrylic, or Acrylic.
    b. Thickness: 20 mils, maximum.
    c. Products:
        1) LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane: www.laticrete.com/#sle.
        2) Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com/#sle.

B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
2. Fluid or Trowel Applied Type:
    a. Material: Synthetic rubber or Acrylic.
    b. Thickness: 25 mils, minimum, dry film thickness.
    c. Products:
        1) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.

2) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
3) TEC, an H.B. Fuller Construction Products Brand; TEC HydraFlex Waterproofing Crack Isolation Membrane: www.tecspecialty.com/#sle.
4) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.

C. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 5/8 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
1. Products:
a. Custom Building Products; WonderBoard Lite Backerboard: www.custombuildingproducts.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
1. Moisture Emission Rate: Not greater than 3 lb per 1000 sq ft per 24 hours, test in accordance with ASTM F1869.
2. Alkalinity (pH): Verify pH range of 5 to 9, test in accordance with ASTM F710.
E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.
C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
E. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
B. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA 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 TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
C. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. 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.

D. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
E. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
G. Form internal angles square and external angles bullnosed.
H. Install ceramic accessories rigidly in prepared openings.
I. Install non-ceramic trim in accordance with manufacturer's instructions.
J. Sound tile after setting. Replace hollow sounding units.
K. Keep control and expansion joints free of mortar, grout, and adhesive.
L. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
M. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
N. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
   1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
B. Over wood substrates, install in accordance with TCNA (HB) Method F142, with standard grout, unless otherwise indicated.
C. Over wood substrate with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with standard grout.

3.5 INSTALLATION - WALL TILE

A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.6 CLEANING

A. Clean tile and grout surfaces.

3.7 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Suspended metal grid ceiling system.
B. Acoustical units.
C. Supplementary acoustical insulation above ceiling.

1.2 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.
C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on suspension system components.
C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.6 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustic Tiles/Panels:
    1. Armstrong World Industries, Inc; <>: www.armstrong.com/#sle.
    2. CertainTeed Corporation; <>: www.certainteed.com/#sle.
    3. USG; <>: www.usg.com/#sle**.**
    4. Chicago Metallic.
    5. Rockfon.
    6. Substitutions: See Section 016000 - Product Requirements.
B. Suspension Systems:
    1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
B. Acoustical Tile Type ACT1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
    1. Basis of Design Product: USG Radar ClimaPlus High-NRC/High-CAC
    2. Size: 24" x 24" inches.
    3. Thickness: 3/4" inches.
    4. Light Reflectance: 0.84 percent, determined in accordance with ASTM E1264.

5. NRC Range: 0.70 to [_____], determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.

C. Glass Fiber Acoustical Panels Type ACT2: Vinyl faced glass fiberASTM E1264 Type X with the following characteristics:
1. Basis of Design Product: USG Climaplus Clean Room
2. Size: 24 by 24 inches.
3. Thickness: 5/8 inches.
4. Light Reflectance: 0.79 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.55 to 0.55, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Surface Pattern: Perforated, small holes.

2.3 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; heavy-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Finish: White painted.

2.4 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Use longest practical lengths.
2. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install units after above-ceiling work is complete.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

G. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.

H. Install hold-down clips on panels within 20 ft of an exterior door.

3.4 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 096500 - RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring.
B. Resilient base.
C. Installation accessories.

1.2 RELATED REQUIREMENTS

A. Section 090561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile 2020.
C. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
E. Concrete Sub-floor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Flooring Material: 100 square feet of each type and color or 10%, whichever is greater.
    3. Extra Wall Base: 10 linear feet of each type and color, or 10%, whichever is greater.
    4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience and approved by flooring manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.7 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions

above 55 degrees F.

1.8 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Construct resilient floor mock-up where indicated on drawings, incorporating all components specified for the location.

1. Minimum size of mock-up is indicated on drawings.
2. Approved mock-up may remain as part of the Work.

2.1 PRE-INSTALLATION

A. Pre-installaton meeting required for resilient flooring prior to installation. Date to be indentifed by schedule.

PART 2 PRODUCTS

3.1 SHEET FLOORING

3.2 TILE FLOORING

A. Vinyl Tile: Surface-decorated, with wear layer.

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. Amtico Company; [_____]: www.amtico.com/#sle.
   b. Shaw Industries Group, Inc. www.shawcontract.com
   c. J&J Flooring Group LLC www.jjflooringgroup.com
   d. Interface www.interface.com
2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Tile Size: As indicated on drawings.
5. Total Thickness: 0.125 inch.
6. Pattern: As indicated on drawings.
7. Color: As indicated on drawings.

3.3 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A, Straight.

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. Burke Flooring; Commercial Wall Base - TS: www.burkeflooring.com/#sle.
   b. Johnsonite, a Tarkett Company; [_____]: www.johnsonite.com/#sle.
   c. Roppe Corp; [_____]: www.roppe.com/#sle.
2. Height: As indicated on Drawings.
3. Length: Roll.
4. Color: As indicated on drawings.
5. Accessories: Premolded external corners and internal corners, or job formed.

3.4 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   a. Burke Flooring; [____]: www.burkeflooring.com/#sle.
   b. Johnsonite, a Tarkett Company; [_____]: www.johnsonite.com.

c. Roppe Corp; [_____]: www.roppe.com.

PART 3 EXECUTION

4.1 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Test in accordance with Section 090561.
2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

4.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

4.3 Installation - General

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

1. Resilient Strips: Attach to substrate using adhesive.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Install flooring in recessed floor access covers, maintaining floor pattern.

G. At movable partitions, install flooring under partitions without interrupting floor pattern.

4.4 Installation - Sheet Flooring

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

B. Cut sheet at seams in accordance with manufacturer's instructions.

4.5 Installation - Tile Flooring

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

4.6 Installation - Resilient Base

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

4.7 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

4.8 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vinyl sheet flooring, adhesively installed.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.3 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016, with Editorial Revision (2021).

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

C. Shop Drawings: Fabrication and installation details, and layout, colors, and widths of game lines and equipment locations.

D. Selection Samples: Manufacturer's color charts for flooring materials specified and game line paints, indicating full range of colors and textures available.

E. Verification Samples: Actual flooring material specified, not less than 12 inch square, mounted on solid backing.

1. Include samples of game lines, illustrating colors selected.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer certified in writing by the flooring manufacturer to be qualified for installation of specified flooring system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.7 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F or to go above 100 degrees F.

PART 2 PRODUCTS

2.1 PREFORMED ATHLETIC FLOORING

A. Manufacturers: All products by the same manufacturer.

1. Ecore International: www.ecorecommercial.com.
2. Substitutions: See Section 016000 - Product Requirements.

B. Vinyl Sheet Flooring:

1. Wearing Surface: Pure polyvinyl chloride, mechanically extruded and uniformly resilient material with uniform color throughout thickness.
2. Backing: None.
3. Sheet Thickness: Minimum 7 mm.
4. Sheet Lengths: As necessary to minimize transverse seams.
5. Tensile Strength: Minimum 1000 psi, per ASTM D412.
6. Durometer Hardness, Type A: Minimum of 65, when tested in accordance with ASTM D2240.

7. Seaming Method: Welding with heat or chemical.
8. Surface Texture: Smooth.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.

C. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

D. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Resilient Sheet Flooring:

1. Unroll flooring and allow to relax before beginning installation.
2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
5. Weld seams using techniques and equipment recommended by manufacturer.
6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.4 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.5 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 096700 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fluid-applied flooring and base.

1.2 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 079200 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.

C. Samples: Submit two samples, 2 by 2 inch in size illustrating color and pattern for each floor material for each color specified.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Top Coat Materials: 2 gallons.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section.

1. Approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resin materials in a dry, secure area.

1.6 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F.

B. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.1 Fluid-Applied Flooring SYSTEMS

A. Fluid-Applied Flooring: Epoxy base coat(s), with broadcast aggregate.

1. Aggregate: Quartz granules.
2. Top Coat: Polyurethane.
3. System Thickness: 1/8 inch, nominal, when dry.
4. Texture: Smooth.
5. Sheen: High gloss.
6. Color: As selected by Architect.
7. Basis of Design Product: Tnemec Company Inc.; Deco-Fleck: www.tnemec.com.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

B. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.

C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.
B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
C. Vacuum clean substrate.
D. Apply primer to surfaces required by flooring manufacturer.

3.3 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.
B. Apply each coat to minimum thickness indicated.
C. Finish to smooth level surface.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

A. Section 090561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016 (Reapproved 2021).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and [_____].

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.5 Warranty

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.7 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tile Carpeting: Subject to compliance with requirements provide products by one of the following:

1. Interface, Inc; <>: www.interfaceinc.com/#sle.
2. Milliken & Company; <>: www.milliken.com/#sle.
3. Tandus; <>: www.tandus.com/#sle.
4. J&J Flooring Group, LLC www.jjflooringgroup.com
5. Shaw Industries Group, Inc. www.shawcontract.com

2.2 MATERIALS

A. Tile Carpeting: <>

1. Product Line: As indicated on Drawings.
2. Size: As indicated on Drawings.

3. Color: As indicated on Drawings.
4. Pattern: As indicated on Drawings..
5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

2.3 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Adhesives:
1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
1. Test in accordance with Section 090561.
2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.

3.3 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.
B. Install carpet tile in accordance with manufacturer's instructions.
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
F. Locate change of color or pattern between rooms under door centerline.
G. Fully adhere carpet tile to substrate.
H. Trim carpet tile neatly at walls and around interruptions.
I. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 097200 - WALL COVERINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall covering.

1.2 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Preparation and priming of substrate surfaces.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on wall covering and adhesive.

C. Shop Drawings: Indicate wall elevations with seaming layout.

Samples: Submit two samples of wall covering, full sheet width by full sheet length inch in size illustrating color, finish, and texture.

D. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 MOCK-UP

A. Provide panel, 2 panel drops wide, full height, illustrating installed wall covering and joint seaming technique.

B. Locate where indicated on drawings.

C. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.8 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.1 Wall Coverings

A. General Requirements:

1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

B. Wall Covering: see finish legend, complying with the following:

1. Color: as indicated in drawings.
2. Pattern: as indicated in drawings.

3. Surface Texture/Coating: as indicated in drawings.

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

D. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

E. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.2 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Marks: Seal with shellac those that may bleed through surface finishes.

F. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.

G. Vacuum clean surfaces free of loose particles.

3.3 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply adhesive to wall surface immediately prior to application of wall covering.

C. Use wall covering in pattern sequence.

D. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.

E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.

F. Butt edges tightly.

G. Overlap adjacent panels as recommended by manufacturer.

H. Horizontal seams are not acceptable.

I. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

J. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

K. Do not install wall covering more than 1/4 inch below top of resilient base.

L. Cover spaces above and below windows, above doors, in pattern sequence from roll.

M. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.5 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 098430 - SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sound-absorbing panels.
B. Mounting accessories.

1.2 RELATED REQUIREMENTS

A. Section 095100 - Acoustical Ceilings: Ceiling suspension system.

1.3 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method 2017.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests 2016.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, and patterns available.
E. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.
    2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.
        a. Provide complete assembly, including mounting devices.
    3. Fabric: For each fabric, color, and pattern installed furnish length equal to 10 percent of amount installed but not fewer than 10 yards.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

PART 2 PRODUCTS

2.1 Fabric-Covered SOUND-ABSORBING UNITS

A. Manufacturers:
    1. Acoustical Panel Systems (APS, Inc.)..
    2. AVL Systems, Inc.
    3. Golterman & Sabo.
    4. Kinetics Noise Control, Inc.

5. MBI Products Company, Inc.
6. Sound Seal
7. Tectum Onc.
8. Substitutions: See Section 016000 - Product Requirements.

B. Sound Absorbing Units: Prefinished, factory assembled fabric-covered panels.
1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

C. Fabric-Covered Acoustical Panels for Walls:
1. Basis of Design Product: Subject to compliance with requirements, provide **Golterman & Sabo, Resolute** R2 or comparable product by an approved manufacturer.
2. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.
a. Facing: 1/16 inch impact-resistant surface laminated to core.
3. Noise Reduction Coefficient (NRC): 1.00 when tested in accordance with ASTM C423
4. Panel Size: As indicated on drawings.
5. Panel Thickness: As required to meet required acoustical performance.
6. Edges: Perimeter edges reinforced by a formulated resin hardener.
7. Corners: Square.
8. Fabric: Standard, Guilford 2100
9. Color: As indicated.
10. Mounting Method: Two-part Z-clips.

2.2 FABRICATION

A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
2. For panels suspended from ceiling, provide fabric covering both sides, with seams only at panel edges.

B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.3 ACCESSORIES

A. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
1. Z-clip hanger and magnet system with magnets recessed into panel frame and designed to engage steel mounting plates secured to substrate with screws.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
1. Plumb and level.
2. Flatness.
3. Width of joints.

3.3 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

END OF SECTION

SECTION 099113 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.
   2. Mechanical and Electrical:
      a. On the roof and outdoors, paint equipment that is exposed to weather or to view, including factory-finished materials.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically indicated.
   9. Ceramic and other types of tiles.
   10. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
   11. Exterior insulation and finish system (EIFS).
   12. Glass.
   13. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.
B. Section 099123 - Interior Painting.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.
B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association Current Edition.
D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
F. SSPC-SP 6 - Commercial Blast Cleaning 2007.
G. SSPC-SP 13 - Surface Preparation of Concrete 1997 (Reaffirmed 2003).

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.7 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 5 feet long by 3 feet wide, illustrating paint color, texture, and finish.

C. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
2. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
1. Behr Process Corporation; <>: www.behr.com/#sle.
2. PPG Paints; <>: www.ppgpaints.com/#sle.
3. Rodda Paint Company; <>: www.roddapaint.com/#sle.
4. Sherwin-Williams Company; <>: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.
1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
a. Products:
1) PPG Paints Speedhide Exterior Latex Satin, 6-2045XI Series. (MPI #15)
2) Sherwin-Williams Resilience, Satin. (MPI #15)
3. Top Coat(s): Exterior Alkyd Enamel; MPI #94 or 96.
a. Products:
1) PPG Paints Interior/Exterior Industrial Enamel, Gloss, 7-282. (MPI #96)
2) PPG Paints Fast Dry 35 Quick Drying Enamel, Gloss, 95-9000.
3) Rodda Porsalite, Semi-Gloss, 745001. (MPI #94)
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
D. Test shop-applied primer for compatibility with subsequent cover materials.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Fiber Cement Siding: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior 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. Remove or repair existing paints or finishes that exhibit surface defects.
D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
E. Seal surfaces that might cause bleed through or staining of topcoat.
F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
G. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
H. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
I. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
K. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
L. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
M. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance.
F. Sand wood and metal surfaces lightly between coats to achieve required finish.
G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

3.6 SCHEDULE - MPI SYSTEMS

A. Substrate: Concrete Vertical Surfaces, Exterior .
   1. MPI System: EXT 3.1A.
   2. Primer: Alkali Resistant Water Based Primer; MPI # 3.
   3. Intermediate Coat: Latex; MPI # 15.
   4. Top Coat: Latex; MPI # 15.
   5. Sheen: Gloss Level 3/4.
B. Substrate: Concrete Horizontal Surfaces, Exterior .
   1. MPI System: EXT 3.2D.
   2. Primer: Alkyd; MPI # 27.
   3. Intermediate Coat: Alkyd; MPI # 27.
   4. Top Coat: Alkyd; MPI # 27.
   5. Sheen: Gloss Level 6.
C. Substrate: Clay Masonry Units, Exterior .
   1. MPI System: EXT 4.1K.
   2. Primer: Alkali Resistant Water Based Primer; MPI # 3.
   3. Intermediate Coat: HIPAC; MPI # 315.
   4. Top Coat: HIPAC; MPI # 315.
   5. Sheen: Gloss Level 3/4.
D. Substrate: Concrete Masonry Units, Exterior .
   1. MPI System: EXT 4.2A.
   2. Primer: Latex Block Filler; MPI # 4.
   3. Intermediate Coat: Latex; MPI # 15.
   4. Top Coat: Latex; MPI # 15.
   5. Sheen: Gloss Level 3/4.
E. Substrate: Fiber Cement Siding, Exterior .
   1. MPI System: EXT 3.3J.
   2. Primer: Alkali Resistant Water Based Primer; MPI # 3.
   3. Intermediate Coat: Latex; MPI # 15.
   4. Top Coat: Latex; MPI # 15.
   5. Sheen: Gloss Level 3/4.

F. Substrate: Wood, Dimension Lumber, Exterior .
   1. MPI System: EXT 6.2A.
   2. Primer: Alkyd/Oil Primer; MPI # 5.
   3. Intermediate Coat: Latex; MPI # 15.
   4. Top Coat: Latex; MPI # 15.
   5. Sheen: Gloss Level 3/4.

G. Substrate: Steel Fabrications, Exterior .
   1. MPI System: EXT 5.1D.
   2. Primer: Alkyd Primer; MPI # 79.
   3. Intermediate Coat: Alkyd; MPI # 94.
   4. Top Coat: Alkyd; MPI # 94.
   5. Sheen: Gloss Level 5.

H. Substrate: Galvanized Metal, Exterior .
   1. MPI System: EXT 5.3L.
   2. Primer: Epoxy Primer; MPI # 101.
   3. Intermediate Coat: Polyurethane; MPI # 72.
   4. Top Coat: Polyurethane; MPI # 72.
   5. Sheen: Gloss Level 6.

END OF SECTION

SECTION 099123 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Glass.
   11. Acoustical materials, unless specifically indicated.
   12. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Shop-primed items.
B. Section 099113 - Exterior Painting.

1.3 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.4 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2016.
B. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating 2005 (Reapproved 2017).
C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials 2020.
D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.
E. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).
F. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.7 MOCK-UP

A. See Section 014000 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 3 feet long by 5 feet wide, illustrating paint color, texture, and finish.

C. Locate where directed by Architect.

D. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.9 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
   2. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.

B. Paints:
   1. Behr Process Corporation: www.behr.com/#sle.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
1. Two top coats and one coat primer.
2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
   a. Products:
      1) Sherwin-Williams ProMar 200 HP Series, Eg-Shel. (MPI #145)
      2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
3. Top Coat Sheen:
   a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
   b. Eggshell: MPI gloss level 3; use this sheen at all locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
2. Two top coats and one coat primer.
3. Top Coat(s): High Performance Architectural Interior Latex; MPI #139, 140, or 141.
   a. Products:
      1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
4. Top Coat Sheen:
   a. Satin: MPI gloss level 4; use this sheen at all locations.
5. Primer: As recommended by top coat manufacturer for specific substrate.

C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
   a. Products:
      1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
3. Top Coat Sheen:
   a. Eggshell: MPI gloss level 3; use this sheen at all locations.

4. Primer: As recommended by top coat manufacturer for specific substrate.

D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, galvanized piping, and [_____].
   1. Shop primer by others.
   2. One top coat <>.
   3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
      a. Products:
         1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
   4. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen at all locations.

E. Paint I-OP-FL - Concrete and Wood Floors to be Painted.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Alkyd Floor Enamel, Gloss; MPI #27.
      a. Products:
         1) PPG Paints Floor and Porch Enamel WB Alkyd, 3-610 Series, Gloss.

2.4 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior 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. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

2. Clean concrete according to ASTM D4258. Allow to dry.

H. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

K. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

L. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

M. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

N. Copper: Remove contamination by steam, high pressure water, or solvent washing.

O. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

P. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

Q. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

R. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 101400 - SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Room and door signs.
B. Cast dimensional characters.
C. Metal plaques.

1.2 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.
B. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
    1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
    2. Submit for approval by Owner through Architect prior to fabrication.
D. Samples: Submit two samplesof each type of sign, of size similar to that required for project, illustrating sign style, font, any exposed accessories, and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Show signage mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
G. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signage that fail in materials or workmanship within specified warranty period.
    1. Failures include, but are not limited to, the following:
        a. Deterioration of finishes beyond normal weathering.
        b. Deterioration of embedded graphic image.
        c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from Substantial Completion.

1.9 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.
2. Concentrated Horizontal Load: As indicated on Drawings.
3. Other Design Load: As indicated on Drawings.
4. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 MANUFACTURERS

A. Panel Signs: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles.

1. Best Sign Systems, Inc; <>: www.bestsigns.com/#sle.
2. Cosco Industries (ADA signs); ADA Series 1: www.coscoarchitecturalsigns.com/#sle.
3. FASTSIGNS; <>: www.fastsigns.com/#sle.
4. Inpro; <>: www.inprocorp.com/#sle.
5. Mohawk Sign Systems, Inc; <>: www.mohawksign.com/#sle.
6. Seton Identification Products; <>: www.seton.com/aec/#sle.
7. Signs & Decal Corp.
8. Vista System

B. Dimensional Letter Signs:

1. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com/#sle.
2. FASTSIGNS; <>: www.fastsigns.com/#sle.
3. Inpro; <>: www.inprocorp.com/#sle.

C. Plaques:

1. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com/#sle.
2. FASTSIGNS; <>: www.fastsigns.com/#sle.

2.3 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 <>, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with applied character panel media as specified.
2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
3. Character Height: 1 inch.
4. Sign Height: 3 inches, unless otherwise indicated.
5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings.

7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", and braille.

C. Building Identification Signs:
1. Use individual metal letters.
2. Mount on outside wall in location indicated on drawings.

D. Other Dimensional Letter Signs: Wall-mounted.

E. Plaque: See Allowance for details.

2.4 SIGN TYPES

A. Flat Signs: Signage media without frame.
1. Edges: Square.
2. Corners: Square.
3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
2. Character Case: Upper case only.
3. Background Color: As selected by Architect from manufacturer full line of colors..
4. Character Color: Contrasting color. As selected by Architect.

2.5 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch.

B. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
1. Total Thickness: 1/8 inch.
2. Letter Thickness: 1/8 inch.
3. Letter Edges: Square.

2.6 PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Plaque Material: Cast aluminum.
2. Plaque Thickness: As indicated on Drawings.
3. Size: 24 inches by 36 inches.
4. Text and Typeface:
a. Character Font: Helvetica, Arial, or other sans serif font.
b. Character Color: Contrast with background color.
5. Border Style: As indicated on drawings.
6. Background Texture: Ripple.
7. Surface Finish: Brushed, satin.
8. Painted Background Color: Light oxide stain.
9. Protective Coating: Manufacturer's standard clear coating.
10. Finishes:
a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
11. Mounting: Concealed studs.

2.7 PLAQUE 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.

B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.8 PANEL SIGNS

A. Panel Sign as indicated on Drawings: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles.

B. Sign-Panel Perimeter: Finish edges smooth.
   1. Edge Condition: As indicated on Drawings.
   2. Corner Condition in Elevation: As indicated on Drawings.

C. Mounting: Manufacturer's standard method for substrates indicated, surface mounted to wall with concealed anchors, adhesive, or two face tape.

D. Surace Finish and Applied Graphics:
   1. Integral Acrylic
   2. Sheet Color: As selected by Architect from full range of industry colors.

E. Text and Typeface:typeface as selected by Architect from manufacturer's full range . Finish raised characters to contrast with background color, and finish Braille to match background color.

F. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus [1/16 inch] < insert dimension> measured diagonally from corner to corner.

2.9 PANEL SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.10 DIMENSIONAL CHARACTERS

A. Cast Characters as indicated on Drawings: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
   1. Character Material: Cast Aluminum.
   2. Character Height: As indicated on Drawings.
   3. Thickness: As indicated on Drawings.
   4. Finishes:
      a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
      b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
   5. Mounting: [As indicated on Drawings] [Concealed studs] [Projecting studs] [Rosette-head through fasteners] [Countersunk flathead through fasteners] .
   6. Typeface: [Times Roman] < Insert requirement>.

2.11 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.

B. Metal Letters:

2.12 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs 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. Comply with AWS for recommended practices in welding and brazing. 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.
7. 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. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

2.13 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. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.14 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.

2.15 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

2.16 CLEAR ORGANIC COATING FOR COPPER-ALLOY FINISHES

A. Clear Organic Coating: Clear, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of methyl methacrylate copolymer with benzotriazole to prevent breakdown of the film in UV light; shop applied in two uniform coats according to manufacturer's written instructions, with interim drying between coats and without runs or other surface imperfections, to a total dry film thickness of 1 mil.

2.17 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.
B. Adhesive: As recommended by sign manufacturer.
C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.
D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
E. 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. For exterior exposure, furnish [nonferrous-metal] [stainless-steel] [or] [hot-dip galvanized] devices unless otherwise indicated
F. Exposed Metal-Fastener Components, General:
   1. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   2. Fastener Heads: For nonstructural connections, use [flathead] [or] [oval countersunk] screws and bolts with tamper-resistant [Allen-head] [spanner-head] [or] [one-way-head] slots unless otherwise indicated
G. Sign Mounting Fasteners:
   1. Concealed Studs: Concealed (blind), threaded studs 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. 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.
   3. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

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. 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.
D. Verify that electrical service is correctly sized and located to accommodate signs.

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. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that sign 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. Plaques Used for Room Identification : Install in locations on walls as indicated on Drawings and according to accessibility standard.

C. 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. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of signage and of suitable quantity to support weight of signage after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as signage is applied and to prevent visibility of cured adhesive at signage edges. Place signage in position, and push to engage adhesive. Temporarily support signage in position until adhesive fully sets.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
4. Shim-Plate Mounting: Provide 1/8-inch- thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using [method specified above] .

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

E. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

F. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and plaques that do not comply with specified requirements. Replace signage 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. Upon 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

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid plastic toilet compartments.
B. Urinal screens.

1.2 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Blocking and supports.
B. Section 102800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
D. Samples: Submit two samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
E. Closeout Submittals: Maintenance data.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Solid Plastic Toilet Compartments: Basis of Design Product: Subject to compliance with requirements, provide Accurate Partitions Corporation, Solid Plastic Paritions, or comparable product by one of the following:
   1. Inpro; Endurant Toilet Partitions: www.inprocorp.com/#sle.
   2. Scranton Products (Santana/Comtec/Capital); [_____]: www.scrantonproducts.com/#sle.
   3. Global Partitions globalpartitions.com

2.2 PLASTIC TOILET COMPARTMENTS

A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
   1. Color: As indicated on drawings..
B. Doors:
   1. Thickness: 1 inch.
   2. Width: 24 inch.
   3. Width for Handicapped Use: 36 inch, out-swinging.
   4. Height: 55 inch.
C. Panels:
   1. Thickness: 1 inch.
   2. Height: 55 inch.
   3. Depth: As indicated on drawings.
D. Pilasters:
   1. Thickness: 1 inch.
   2. Width: As required to fit space; minimum 3 inch.
E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.3 ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Extruded aluminum, anti-grip profile.

C. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.

E. Hinges: Stainless steel, manufacturer's standard finish.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

F. Door Hardware: Stainless steel, manufacturer's standard finish.
   1. Door Latch: Slide type with exterior emergency access feature.
   2. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Corner guards.

1.2 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).

B. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies 2014.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Maintenance Data: For each type of product . Include information regarding recommended and potentially detrimental cleaning materials and methods.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Protect work from UV light damage.

D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in conformance with manufacturer's recommendations for each type of item.

E. Store products in either horizontal or vertical position, in conformance with manufacturer's instructions.

1.5 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Corner Guards:

1. Babcock-Davis; <>: www.babcockdavis.com/#sle.
2. Inpro; <>: www.inprocorp.com/#sle.
3. Koroseal Interior Products; <>: www.koroseal.com/#sle.
4. Nystrom, Inc; <>: www.nystrom.com/#sle.
5. Trim-Tex, Inc; <>: www.trim-tex.com/#sle.

2.2 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for conformance to applicable provisions of ASTM D256 and/or ASTM F476.

2.3 PRODUCT TYPES

A. Corner Guards - Surface Mounted:

1. Material: High impact vinyl with full height extruded aluminum retainer.
2. Material: Type 304 stainless steel, No. 4 finish, 16 gage, [_____] inch thick.
3. Width of Wings: 1 1/2" or 2" inches.
4. Corner: Square.
5. Color: As selected from manufacturer's standard colors.
6. Length: One piece XX inches

7. Preformed end caps.

B. Adhesives and Primers: As recommended by manufacturer.

C. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

2.4 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that substrate surfaces for adhered items are clean and smooth.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to [____] inches high.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.
B. Commercial shower and bath accessories.
C. Diaper changing stations.
D. Utility room accessories.

1.2 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings 2018, with Editorial Revision (2021).
F. ASTM C1036 - Standard Specification for Flat Glass 2016.
G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2004, with Editorial Revision (2016).
I. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

PART 2 PRODUCTS

2.1 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
    1. Grind welded joints smooth.
    2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
B. Keys: Provide two (2) keys for each accessory to Architect; master key lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
F. Zinc Alloy: Die cast, ASTM B86.
G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
H. Adhesive: Two component epoxy type, waterproof.
I. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
J. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.2 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.3 Commercial Toilet Accessories

A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, aluminum, eccentric-shaped plastic spindle for one-half revolution delivery designed to prevent theft of tissue roll.
   1. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-274 ClassicSeries toilet paper dispenser or comparable product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco USA

B. Mirrors: Stainless steel channel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: 24" x 30".
   3. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-165 2430 or comparable product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco

C. Grab Bars: Satin stainless steel, nonslip grasping surface finish.
   1. Standard Duty Grab Bars:
   2. Push/Pull Point Load: 250 pound-force, minimum.
   3. Dimensions: 1 1/2" inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
   4. Finish: Satin.
   5. Length and Configuration: 18", 36", and 42" as indicated on drawings and located complying with ADA requirements.
   6. Basis-of-Design: Subject to compliance with requirements, provide Bobrick Model 6806 Series grab bars or product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco USA

2.4 Commercial Shower and Bath Accessories

A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.

B. Shower Curtain:
   1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   2. Size: 36 by 72 inches, hemmed edges.
   3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
   4. Color: White.
   5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
   1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of White color.
   2. Size: ADA Standards compliant.
   3. Products:
      a. Seachrome Corporation; Accessibility Seats- L-Shaped Transfer with Swing-down Legs, Reversible: www.seachrome.com/#sle.

D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

E. Towel Bar: Stainless steel, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
   1. Length: 24 inches.
   2. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-6737 towel bar or comparable product by one of the following:
      a. AJW Architectural Products
      b. Bradley Corporation
      c. Gamco USA

F. Towel Pin: Stainless steel, 3 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
   1. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-6777 towel pin or comparable product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco USA

G. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
   1. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-6717 robe hook or comparable product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco USA

2.5 Diaper Changing Stations

A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.

B. Diaper Changing Station: Polypropylene wall-mounted folding diaper changing station for use in commercial facilities.
   1. Material: Polypropylene.
   2. Mounting: Surface.
   3. Color: Gray.
   4. Basis-of-Design: Subject to compliance with requirements, provide Bobrick KC200 baby changing station or comparable product by one of the following:
      a. AJW Architectural Products
      b. American Specialties, Inc.
      c. Bradley Corporation
      d. Gamco USA

2.6 Utility Room Accessories

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: 2, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   4. Length: Manufacturer's standard length for number of holders/hooks.
   5. Basis-of-Design: Subject to compliance with requirements, provide American Specialties, Inc. 1315-3 utility shelf/mop and broom holder or comparable product by one of the following:
      a. AJW Architectural Products
      b. Bradley Corporation
      c. Gamco USA

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
D. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

A. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Mounting Heights: As required by accessibility regulations and as indicated on drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets.

1.2 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
B. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).
C. UL (DIR) - Online Certifications Directory Current Edition.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions for each type of product.
C. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. Ansul, a Tyco Business: www.ansul.com.
   2. Kidde, a unit of United Technologies Corp: www.kidde.com.
   3. Nystrom, Inc: www.nystrom.com/sle.
   4. Amerex..
   5. JL Industries, Inc.; a division of the Activar Construction Products Group.
   6. Larsens Manufacturing Company.
   7. Guardian Fire Equipment, Inc.
B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group: www.activarcpg.com/#sle.
   2. Kidde, a unit of United Technologies Corp: www.kidde.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com.
   4. Nystrom, Inc: www.nystrom.com/sle.
   5. Guardian Fire Equipment, Inc..

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
   1. Basis of Design Product: Subject to compliance with requirements, provide Larsens Manufacturing Company; MP10 or comparable product by one of the manufacturers listed above.
   2. Class: A:B:C type.
   3. Size: 10 pound.
   4. Finish: Baked polyester powder coat, red color.
   5. Temperature range: Minus 65 degrees F to [___] degrees F.
C. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.

1. Basis of Design Product: Subject to compliance with requirements, provide Larsens Manufacturing Company; WC-6L or comparable product by one of the manufacturers listed above.
2. Class: K type.
3. Size: 1.6 gallons.
4. Finish: Polished stainless steel.
5. Temperature range: Minus 20 degrees F to 120 degrees F.

2.3 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Cabinet Construction: Non-fire rated.

C. Fire Rated Cabinet Construction: One-hour fire rated.

D. Cabinet Configuration: Semi-recessed type with multipurpose dry chemical fire extinguisher.
1. Basis of Design Product: Subject to compliance with requirements, provide Larsens Manufacturing Company; 2409-R7 Architectural Series Vertical Duo or comparable product by one of the manufacturers listed above.
2. Size to accommodate accessories.
3. Trim: Square edge.
4. Trim and Door Material: Steel sheet.
5. Door Glazing: Clear transparent acrylic sheet.
6. Indentification: Identify fire extinguisher in fire protection cabinet with the words FIRE EXTINGUISHER. Comply with requirements of authorities having jurisdiction.
   a. Location: Applied to cabinet door.
   b. Application process: Pressure-sensitive vinyl letters.
   c. Lettering color: Red.
   d. Orientation: Vertical.

E. Cabinet Configuration: Semi-recessed type with wet chemical fire extinguisher.
1. Basis of Design Product: Subject to compliance with requirements, provide Larsens Manufacturing Company; 2712-RK Architectural Series Vertical Duo or comparable product by one of the manufacturers listed above.
2. Size to accommodate accessories.
3. Trim: Square edge.
4. Trim and Door Material: Steel sheet.
5. Door Glazing: Clear transparent acrylic sheet.
6. Indentification: Identify fire extinguisher in fire protection cabinet with the words FIRE EXTINGUISHER. Comply with requirements of authorities having jurisdiction.
   a. Location: Applied to cabinet door.
   b. Application process: Pressure-sensitive vinyl letters.
   c. Lettering color: Red.
   d. Orientation: Vertical.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and levelin wall openings, 60 inches from finished floor to top of cabinet, confirm height acceptable to authorities having jurisdiction.
C. Secure rigidly in place.
D. Place extinguishers in cabinets.

END OF SECTION

SECTION 105617 - WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel shelf standards, brackets, and accessories.

1.2 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking in walls for attachment of standards.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products under cover and elevated above grade.

B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Steel Shelf Standards and Brackets:

1. Knape & Vogt Manufacturing Company; 87™/187™ Series: www.knapeandvogt.com/#sle.

2.2 COMPONENTS

A. Steel Shelf Standards, Brackets, and Accessories:

1. Super-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch increments along entire length of standard, drilled and countersunk for screws.
   a. Acceptable Product: KV 87/187.
   b. Load Capacity: Recommended by manufacturer for loading of 540 to 1,060 pounds per pair of standards.
   c. Face Width: 5/8 inch, single slotted.
   d. Material: 12 gage, 0.1046 inch sheet steel.
   e. Lengths: As indicated on drawings.
   f. Finish: Powder-coated, white; provide screws with matching heads.
   g. Brackets: 12 gage, 0.1046 inch sheet steel, reinforced, locking into slots with molded nylon cam lock lever; size to suit shelves; same finish as standards.
   h. Bracket Quantity: Provide one bracket for each 12 inches of standard length.

B. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Mount standards to solid backing capable of supporting intended loads.
C. Install brackets, shelving, and accessories.

3.4 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 107500 - FLAGPOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum Flagpoles.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.3 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains 2016.

B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube 2016.

C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles 2007.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pole, accessories, and configurations.

C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

D. Delegated-Design Submittal: For flagpoles.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flagpoles:

1. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.
2. American Flagpole; <>: www.americanflagpole.com/#sle.
3. Concord Industries, Inc; <>: www.concordindustries.com/#sle.
4. Pole-Tech Co, Inc; <>: www.poletech.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

2.2 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001

1. Material: Aluminum.
2. Design: Straight shaft.
3. Mounting: Ground mounted type.
4. Nominal Height: 25 ft; measured from nominal ground elevation.
5. Halyard: Interior type , electric operation.

B. Performance Requirements:

1. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design flagpole assemblies.
2. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.
3. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to [____] miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.3 POLE MATERIALS

A. Aluminum: ASTM B241/B241M , 6063 alloy , T6 temper.

2.4 ACCESSORIES

A. Finial Ball: Stainless steel, 6 inch diameter.

B. Cleats: 9 inch size, aluminum with galvanized steel fastenings, two per halyard.

C. Halyard: 5/16 inch diameter polypropylene, braided, white.

D. Halyard Flag Snaps: Nylon swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

E. Finish exposed metal surfaces to match flagpole.

2.5 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of as indicated.

2.6 MISCELLANEOUS MATERIALS

A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

B. Sand: ASTM C 33/C 33M, fine aggregate.

C. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 07 92 00 "Joint Sealants."

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.7 FINISHING

A. Aluminum: Mill finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

D. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

E. Place concrete, as specified in Section 03 30 00 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 INSTALLATION

A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

3.4 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.5 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 122400 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior manual roller shades.

1.2 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

A. WCMA A100.1 - Safety of Window Covering Products 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
   1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

D. Selection Samples: Include fabric samples in full range of available colors and patterns.
   1. Motorized Shades: Include finish selections for controls.

E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum three years of documented experience with shading systems of similar size and type.
   1. Manufacturer's authorized representative.
   2. Factory training and demonstrated experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.8 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:

1. Shade Hardware: One year.
2. Electric Motors: One year.
3. Fabric: One year.
4. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.1 Manufacturers

A. Interior Manually Operated Roller Shades:

1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
3. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
4. MechoShade Systems LLC; Mecho/5 System: www.mechoshade.com/#sle.
5. SWFcontract, a division of Springs Window Fashions, LLC.; <>: www.swfcontract.com/#sle.
6. PowerShades..

2.2 Roller Shades

A. General:

1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:

1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Roll Direction: Roll down, closed position is at window sill.
   b. Mounting: Window jamb mounted - inside, between jambs.
   c. Size: As indicated on drawings.
   d. Fabric: As indicated on drawings. See finish schedule
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.

b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
c. Chain Retainer:
1) Chain tensioning device complying with WCMA A100.1.
2) Manufacturer's standard clip.

2.3 Roller Shade FABRICATION

A. Field measure finished openings prior to ordering or fabrication.
B. Dimensional Tolerances: As recommended in writing by manufacturer.
C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.
B. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.
B. Replace shades that cannot be cleaned to "like new" condition.

3.5 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.
B. See Section 017900 - Demonstration and Training, for additional requirements.
C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.6 PROTECTION

A. Protect installed products from subsequent construction operations.
B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 123200 - MANUFACTURED WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured standard and custom casework, with cabinet hardware.
B. Countertops.

1.2 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
B. Section 092116 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
C. Section 096500 - Resilient Flooring: Resilient wall base.
D. Section 123600 - Countertops: Additional requirements for countertops.

1.3 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.4 REFERENCE STANDARDS

A. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
B. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors, reinforcements, and blocking, placement dimensions and tolerances, clearances required, and keying information.
D. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches.
    1. Plastic laminate samples, for color, texture, and finish selection.
E. Maintenance Data: Manufacturer's recommendations for care and cleaning.
F. Finish touch-up kit for each type and color of materials provided.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
B. Acceptance at Site:
    1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
C. Storage:

1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:

1. Ruptured, cracked, or stained finish coating.
2. Discoloration or lack of finish integrity.
3. Cracking or peeling of finish.
4. Delamination of components.
5. Failure of adhesives.
6. Failure of hardware.

PART 2 PRODUCTS

2.1 CASEWORK, GENERAL

A. Plastic Laminate Faced Cabinets: Custom Grade.

2.2 FABRICATION

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Construction: As required for selected grade.

C. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.

D. Hardware Application: Factory-machine casework members for hardware that is not surface applied.

E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

F. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.

G. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.

2.3 PLASTIC-LAMINATE-CLAD CASEWORK

A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.

1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
   a. Base Cabinets: 22 inches.
   b. Tall Cabinets: 22 inches.
   c. Wall Cabinets: 16 inches.
3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
   a. Finish: Matte or suede, gloss rating of 5 to 20.
   b. Surface Color and Pattern: As indicated on drawings.
   c. Cap exposed plastic laminate finish edges with plastic trim.

2.4 COUNTERTOPS

A. Countertops: As specified in Section 123600.

2.5 CABINET HARDWARE

A. Comply with BHMA A156.9 requirements.
   1. Acceptable base materials for plated finishes include brass, bronze, and steel.
B. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
   1. Hinged Doors: Cam type lock, bright chromium plated over nickel on base material.
C. Shelves in Cabinets:
   1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
D. Swinging Doors: Hinges, pulls, and catches.
   1. Hinges: Concealed, number as required by referenced standards for width, height, and weight of door.
      a. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
         1) European-Style Hinges for Overlay Doors: 110 degree opening angle.
   2. Pulls: Chrome wire pulls, 4 inches wide.
   3. Catches: Magnetic.
E. Drawers: Pulls and slides.
   1. Pulls: Chrome wire pulls, 4 inches wide.
   2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.
F. Door and Drawer Sliencers.

2.6 MATERIALS

A. Wood-Based Materials:
   1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
   2. Composite Wood Panels: Containing no urea-formaldehyde resin binders.
B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications. complying with Grade requirements, and standard with the manufacturer.
C. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.

2.7 ACCESSORIES

A. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Use at exposed edges.
B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
C. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
D. Grommets: Standard plastic grommets for cut-outs, in color [____].
E. Sealant for Use in Casework Installation:
   1. Manufacturer's recommended type.

PART 3 EXECUTION

3.1 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.2 EXAMINATION

A. Site Verification of Environmental Conditions:
   1. Do not deliver casework until the following conditions have been met:
      a. Building has been enclosed (windows and doors sealed and weather-tight).

b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
c. Ceiling, overhead ductwork, piping, and lighting have been installed.
d. Installation areas do not require further “wet work” construction.

B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.

C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inchper story.
2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.

D. Verify adequacy of support framing and anchors.

E. Verify that service connections are correctly located and of proper characteristics.

3.3 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.

G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.

H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.

I. Install hardware uniformly and precisely.

J. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.

K. Replace units that are damaged, including those that have damaged finishes.

3.4 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.5 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.6 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.
B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

SECTION 123600 - COUNTERTOPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Countertops for architectural cabinet work.

1.2 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework.

1.3 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard 2016.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications 2016.
C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
D. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material 2013.
E. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.
F. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
G. PS 1 - Structural Plywood 2009 (Revised 2019).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
    1. Preparation instructions and recommendations.
    2. Storage and handling requirements and recommendations.
    3. Specimen warranty.
C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD 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.

PART 2 PRODUCTS

2.1 COUNTERTOPS

A. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
    1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
        a. Manufacturers: Subject to compliance with requirements provide products by one of the following:
            1) Formica Corporation: www.formica.com.
            2) Lamin-Art, Inc: www.laminart.com.
            3) Panolam Industries International, Inc Nevamar: www.nevamar.com.
            4) Panolam Industries International, Inc Pionite: www.pionitelaminates.com.
            5) Wilsonart: www.wilsonart.com.

b. Laminate Core Color: Same as decorative surface.
c. Finish: Matte or suede, gloss rating of 5 to 20.
d. Surface Color and Pattern: As indicated on drawings.

2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
3. Back and End Splashes: Same material, same construction.
4. Fabricate in accordance with manufacturer's standard requirements.

B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 1/2 inch, minimum.
2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
a. Manufacturers: Subject to compliance with requirements provide products by one of the following:
1) Avonite Surfaces: www.avonitesurfaces.com.
2) Dupont: www.corian.com.
3) Formica Corporation: www.formica.com.
4) LG Hausys America, Inc.: www.lghausys.com
5) Wilsonart; [_____]: www.wilsonart.com/#sle.
b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
c. Color and Pattern: As indicated on drawings.
3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Fabricate in accordance with manufacturer's standard requirements.

C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 3/4 inch, minimum.
2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
a. Manufacturers:
1) E.I. du Pont de Nemours and Company: www.dupont.com
2) Daltile; ONE: www.daltilestonecenter.com
3) Consentino; Silestone USA: www.silestoneusa.com
4) Terrazzo & Marble Supply Companies; DIFINITI Quartz: www.tmsupply.com/#sle.
5) Terrazzo & Marble Supply Companies; Diresco Belgium Quartz, a brand of Diresco - North America: www.tmsupply.com/#sle.
6) Wilsonart: www.wilsonart.com.
b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
c. Finish on Exposed Surfaces: Polished.
d. Color and Pattern: As indicated on drawings.
3. Other Components Thickness: 3/4 inch, minimum.

4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Fabricate in accordance with manufacturer's standard requirements.

2.2 MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.
B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
F. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.3 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.
C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
C. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING

A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel building frame.
B. Insulated Metal wall and roof panels including soffits.
C. Exterior doors.

1.2 SCOPE

A. ***<u>Design Criteria:</u> The Contract includes a metal building system which may require deviations from the manufacturer's standard configurations. The drawings indicate (sizes, profiles, and dimensional requirements) of the pre-engineered metal building system. The design criteria, load limits, and other requirements <u>may not</u> be deviated from without written approval from the Architect. Metal buildings systems conforming to all performance characteristics without deviations, may be considered. Any deviations that may result in changes or additional costs, including all Architectural and Engineering services to review and remedy such deviations, shall be the full responsibility of the Sub-Contractor providing the building.***

1. Some of the special requirements are as follows (See Structural and Architectural Drawings):
    a. Column locations and spacing.
    b. Bracing location and type.
    c. Connections for structural components by other suppliers.
    d. Additional loading.
    e. Maximum load limits on foundations.
    f. Supply anchor bolts.
    g. Additional framing and loads to support mechanical equipment.
    h. Collateral roof loading of misc. equipment as indicated in Structural Drawings.
    i. Girt locations as shown.
    j. Gutter and eave details.
    k. Building Stiffness as indicated in Structural Drawings.
    l. Meet uplift as indicated in Structural Drawings.
2. If the manufacturer discovers any of the criteria to be in conflict with any other criteria and/or considers any criteria to be prohibitively expensive, the Sub-Contractor is obligated to inform the Architect prior to bid opening so that a formal interpretation or change by be issued in writing. Unless there is a formal modification to the Contract, all requirements shall be fulfilled at no additional cost to the Owner/Design Team.

1.3 RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between accessory components and wall system.
B. Section 081113 - Hollow Metal Doors and Frames.
C. Section 083613 - Sectional Doors.

1.4 REFERENCE STANDARDS

A. AISC 360 - Specification for Structural Steel Buildings 2016.
B. ASCE/SEI 24 - Flood Resistant Design and Construction 2014.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.
G. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality 2014.
H. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2021.
I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
J. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
K. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2017.
L. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference 2005 (Reapproved 2017).
M. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference 2011 (Reapproved 2018).
N. ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems 2016.
O. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
P. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).
Q. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
R. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).
S. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
T. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems 2018.
U. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
V. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Post meeting record to project website.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on profiles, component dimensions, fasteners.
C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, installation; framing anchor bolt settings, sizes, and locations from datum, foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
D. Samples: Submit two samples of precoated metal panels for each color selected, 12 by 12 inch in size illustrating color and texture of finish.
E. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.

G. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
   1. Name and location of Project.
   2. Order number.
   3. Name of manufacturer.
   4. Name of Contractor.
   5. Building dimensions including width, length, height, and roof slope.
   6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
   7. Governing building code and year of edition.
   8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
   9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
   10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

H. Sample warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.8 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
   1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
   2. Comply with applicable code for submission of design calculations as required for acquiring permits.
   3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
   1. Not less than5years ofdocumented experience
   2. Accredited by IAS in accordance with IAS AC472.

C. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years experience; or approved by manufacturer.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide 20 year manufacturer warranty for Weathertightness for Standing-Seam Metal Roof Panels and Metal Panel Finishes.
   1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. Butler Manufacturing Company; <>: www.butlermfg.com.
   2. Ceco Building Systems; <>: www.cecobuildings.com.
   3. Nucor Building Systems; <>: www.nucorbuildingsystems.com.
   4. Substitutions: See Section 016000 - Product Requirements.

2.2 ASSEMBLIES

A. Single span rigid frame; tapered beam; continuous beam frame..
B. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, and wind bracing.
C. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, insulation, and liner sheets, and accessory components.
D. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, and liner panels, and accessory components.

2.3 PERFORMANCE REQUIREMENTS

A. Design structural members to withstand dead load, applicable snow load, and design loads due to pressure and suction of wind calculated in accordance with applicable code.
B. Design structural members to withstand Class 90 wind uplift in accordance with UL 580.
C. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of per plans of span.
D. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
E. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 120 degrees F.

2.4 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A36/A36M.
B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
D. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with no preference for protective coating.
E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
F. Welding Materials: Type required for materials being welded.
G. Primer: SSPC-Paint 20 zinc rich.
H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

2.5 MATERIALS - WALLS AND ROOF

A. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
B. Insulation: formaldehyde-free fiberglass batt or fiberglass blanket complying with ASTM C 991 Type 1 and ASTM E 84 with a thermal resistance and thickness as following:
   1. R-30: 9-1/2" inches.
C. Vapor Barrier Liner Fabric: Syseal type woven, reinforced, high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene coatings, as follows:
   1. Product complies with ASTM C 1136, Types I through Type VI.
   2. Perm rating: 0.02 in accordance with ASTM E 96.
   3. Flame/Smoke Properties: 25/50 in accordance with ASTM E 84.
D. Vapor Barrier Lap Sealant: Manufacturer's standard type.
E. Vapor Barrier Tape/Patch Tape: Manufacturer's standard type.
F. Straps: Galvanized, primed, and painted to match specified finish color on the exposed side.

G. Thermal Breaks:
   1. 1/8 inch thick by 3 inch wide white, closed-cell polyethylene foam with pre-applied adhesive film and peel-off backing.
   2. Polystyrene Snap-R snap-on thermal blocks.
H. Joint Seal Gaskets: Manufacturer's standard type.
I. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
J. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
K. Roof Curbs: Insulated metal same as roofing, 1 1/2" inch thick, designed for imposed equipment loads, anchor fasteners to equipment, counterflashed to metal roof system.
L. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.6 COMPONENTS

A. Doors and Frames: Specified in Section 081113.
B. Windows: Specified in Section 084313.
C. Installed Thermal Resistance of Wall System: R-value of 13 + 13ci.
D. Installed Thermal Resistance of Roof System: R-value of 30.
E. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
   1. If retaining option in "Design Loads" Subparagraph below, indicate minimum live, dead, snow, collateral, seismic, wind, and uplift loads and load combinations on Drawings as applicable.
   2. Design Loads: As indicated on Drawings.
   3. Retain one of two "Deflection and Drift Limits" subparagraphs below, if required.
   4. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
   5. Deflection and Drift Limits: No greater than the following:
      a. Purlins and Rafters: see plans.
      b. Girts: see plans.
      c. Metal Roof Panels: Vertical deflection of **1/240** of the span.
      d. Metal Wall Panels: Horizontal deflection of **1/120** of the span.
      e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
      f. Lateral Drift: see plans.
F. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
G. 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: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
H. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

I. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:
   1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

J. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
   1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

K. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

L. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

M. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 60.

N. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.

2.7 FABRICATION - FRAMING

A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.

B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.

C. Provide framing for rooftop unit equipment openings.

D. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

A. Roofing: Standing-Seam, Vertical-Rib, Metal Roof Panels: Formed with interlocking ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; 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.
   1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      a. Exterior Finish: Two-coat fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   2. Clips: One-piece fixed to accommodate thermal movement.
   3. Joint Type: Mechanically seamed.
   4. Panel Coverage: 16 inches (406 mm).
   5. Panel Height: 2 inches (51 mm).
   6. Basis of Design: MBCI BattenLok HS

B. Siding: Concealed-Fastener, Metal Wall Panels: Basis of Design is MBCI The Designer Series.
   1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      a. Exterior Finish: Fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   2. Panel Profile: As selected by Architect from manufacturer's full range.
   3. Panel Coverage: As selected by Architect from manufacturer's full range.
   4. Panel Height: 1 3/4”.

C. Soffit: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
   1. Metal Soffit Panels: Basis of Design MBCI Artisan Series L12 with Beads.
      a. Finish: Match finish and color of metal roof panels.
D. Interior Metal Wall & Liner Panel: Minimum [0.024] inch metal thickness, PBU profile indicated, 3/4" inch deep, lapped edges fitted with continuous gaskets.
E. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
F. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with [____] inch thick sheet.
G. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
H. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as roofing metal.
B. Form gutters and downspoutsand scuppers of Box Gutter profile and sizeindicated to collect and remove water. Fabricate with connection pieces.
C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360.
B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
C. Set column base plates with non-shrink grout to achieve full plate bearing.
D. Do not field cut or alter structural members without approval.
E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.
B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
C. Fasten cladding system to structural supports, aligned level and plumb.
D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
E. Provide expansion joints where indicated.
F. Use concealed fasteners.
G. Install insulationand vapor retarder utilizing metal panel fastened to framing for attachment.
H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
B. Apply bituminous paint on surfaces in contact with cementitious materials.
C. Connect downspouts to storm sewer system.

3.5 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION

DIVISION 21 – FIRE SPRINKLER SYSTEM

21-1 GENERAL:

a) Hereinafter, all reference to “this contractor,” “the contractor,” etc., unless specifically preceded by a trade category, shall apply to the Sprinkler Contractor.

b) Design Engineer hereinafter abbreviated D/E shall mean the engineering firm, RTM Consulting Engineers, 3333 E. Battlefield, Suite 1000, Springfield, MO 65804, Telephone (417) 881-0020. Contact Person: Tyler Enserro.

21-2 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. Single story, light hazard, automatic, water suppression with gymnasium and future kitchen.

b) 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 for a single story, light hazard intermediate school with a kitchen and gymnasium. Water shall be the suppression agent on the wet pipe system. It is anticipated to upsize any piping as required and to not provide a fire pump for the single story building.

c) 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 Owner’s insurance company. All flow indicators, gongs, horns, etc., shall be included as part of this contract.

21-3 FEES AND PERMITS:

a) The Contractor shall secure and pay for all permits, license, 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.

21-4 PROTECTION OF WORK:

a) The Contractor shall take the necessary precautions required to protect his work as well as the work of other trades against any damages.

21-5 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 shown 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. Show hanger locations. Plans shall be submitted prior to A/E for head locations approval.

c) At project closeout, submit three (3) 1/8-inch scaled, dimensioned, record drawings to A/E of installed fire protection piping and equipment.

d) The sprinkler system shall be a complete system as required by local authorities. All wiring required for the system shall be provided by the Contractor and shall be included in the submittal package. Submit to Agency having jurisdiction for approval. Submit one (1) approved copy, bearing stamp and/or signature of Agency having jurisdiction, before proceeding with installation.

e) Submit certification upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13 and NFPA 14, and also that system is operational, complete, and has no defects.

21-6 CODES AND ORDINANCES:

a) The Contractor shall comply with all requirements, regulations, code, ordinance, ruling or Fire Underwriters' requirements, NFPA, and Owner's insurance company applicable to this class of work. Furthermore, they shall include, but shall not be limited to, codes listed in other sections of these specifications.

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.

21-7 ACCEPTABLE MANUFACTURERS:

a) Viking, Reliable, Tyco or equal will be acceptable.

21-8 CAD/BIM FILE REQUESTS:

a) CAD files and/or BIM models (only where created as part of the project design) are the property of the D/E and are only available upon documented written request. Prior to receiving any CAD files or models, the contractor shall submit a drawing cost fee of $50/drawing up to a maximum $1500 (BIM models are $1500). In addition, the contractor must sign a Third Party User Agreement and Drawing Request Form which must be forwarded to the D/E office prior to any CAD files being released. This form is available from the D/E upon request.

21-9 QUALIFICATION OF SPRINKLER CONTRACTOR:

a) Fire protection work shall be installed by a firm with at least three (3) years of successful installation experience on projects with fire protection work similar to that required for project by a qualified Contractor (sprinkler fitter or per jurisdictional dictates). The Contractor's design shall be stamped by a Registered Professional Engineer licensed in the state of the project.

21-10 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 civil engineering drawings. The contractor must consult the City water department and local authorities, provide necessary materials and labor to conform to 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, 14 and 20.

b) Existing water flow and pressure shall be verified with local water utility company prior to preparing shop drawings. Existing flow information available is for 58 psi static, 50psi residual at hydrant #281 at Webster Elementary on Locust flowing 1190 gpm at 50 psi pitot at hydrant #280 in front of Hubbell on Locust Street.

c) Provide where indicated on plans watts model LF709, lead free, double-check backflow preventers with strainer and butterfly valves. Equal by Fabco, Hershey, Ames, or Wilkins will be acceptable.

21-11 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.

21-12 EQUIPMENT AND MATERIALS:

a) All materials and equipment furnished as part of this contract shall be UL listed, Owner's insurance company approved, and in compliance with applicable provisions of the NFPA.

b) No plastic piping will be allowed.

21-13 SPRINKLER HEADS:

a) Unless indicated otherwise, sprinkler heads shall be as follows:

1. Exposed areas without ceilings-brass, unplaited sprinklers.

   A. All sprinkler heads in multi-purpose rooms shall be provided with sprinkler head guards

2. Finished ceiling areas-concealed mount brass, unplaited sprinklers with white cover plate and trim.

3. Areas with raised ceilings or no plenum space-sidewall quick response heads, all exposed parts polished chrome finish.

b) Temperature rating of fusible plug or link of sprinklers shall be appropriate for the ambient conditions in the immediate areas.

c) Flexible stainless-steel hose with fittings for fire protection service that connect sprinkler heads to the branch lines in suspended ceilings shall be as allowed by the local jurisdiction and manufactured by FlexHead Industries.

1. Straight and angled hoses be 100%, type 304 stainless steel and shall be fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch (25.4 mm) true-bore internal corrugated hose diameter and limited to a maximum length of 3 feet and rated for 175 psi maximum pressure.

2. Shall attach to lay-in and hard ceilings with a multi-port style, galvanized ceiling bracket having self-securing integrated Snap-on clip ends that attach directly to the ceiling with tamper-resistant screws.

3. Flexible hose and fittings shall comply with NFPA-13 and perform in accordance with FM 1637 and UL 2443.

4. Equal by prior approval only.

d) 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

e) Spare sprinkler heads shall be mounted in emergency sprinkler cabinet. Cabinet shall be located in mechanical room. See drawings for location.

21-14 DESIGN AND CALCULATION:

a) Contractor shall perform necessary calculations required for proper design and installation of the sprinkler system for the entire building (current building and future 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 Engineer one (1) week before the bid opening date. No sprinkler pipe penetration will be allowed through HVAC duct system.

21-15 FIRE DEPARTMENT CONNECTIONS:

a) Contractor shall provide fire department type connection type and location where shown on plan. Coordinate the exact location, pipe threads, and fittings with the local fire department to ensure exact match.

21-16 MISCELLANEOUS EXECUTION:

a) All sprinkler heads 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) Unless coordinated with other trades, all piping shall be installed within 6 inches of structure. Offset around obstacles as necessary and return piping to within 6 inches of structure as close to offset as possible. Branch piping shall be run between concrete stem and steel joists in rooms without ceilings.

c) Sprinkler heads shall be installed in the center of ceiling tiles. Center shall mean within 2” of the center of the tile with all sprinkler heads aligned within room.

21-17 ELECTRICAL REQUIREMENTS:

a) Electric tamper switches are not shown but are required wherever a shutoff valve is installed in the sprinkler system. The Contractor shall be responsible for providing the tamper switch and associated wiring to connect the fire alarm system. All wiring shall be in accordance with Division 26.

b) The sprinkler contractor shall provide written verification and owner observance of operation of the notification system contacting the owner’s monitoring service.

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.

21-18 INSPECTIONS AND TESTING:

a) The fire sprinkler system Engineer of Record shall inspect the sprinkler system installation for conformance with the sprinkler system design documents, the requirements of NFPA 13, and all codes applicable to the design and installation. Upon completion of the inspection, the Engineer of Record shall submit to the Contractor, Architect, and Engineer a report listing all deficiencies, conflicts, errors, etc., found during the inspection. The report shall be submitted no less than two (2) weeks prior to the scheduled date of substantial completion and shall bear the seal and signature of the Design Engineer.

Work required addressing deficiencies, conflicts, errors, etc., listed in the fire sprinkler Engineer of Record's inspection report shall be performed by the Contractor and his own expense. As-built record drawings and hydraulic calculations shall be revised to include any and all additions and modifications and shall bear the seal and signature of the Engineer of Record.

b) Upon completion of the fire sprinkler system installation, the Engineer of Record shall inspect and test the system in accordance with NFPA 13 requirements for system acceptance and system operational tests in the presence of the sprinkler system Design Engineer of record and a representative of the authority having jurisdiction. The "Contractors Material and Test Certificate for Aboveground Piping" and a report of system's operational tests shall be submitted with the fire sprinkler as-built record documents. The acceptance test certificates and operational test reports shall indicate the date of the tests and bear the signatures of the installing contractors performing the tests, and the Design Engineer of Record and the authority having jurisdiction witnessing the tests.

END OF DIVISION 21

DIVISION 22 – PLUMBING

22-1 CONTRACT DOCUMENTS:

a) All contract documents including drawings, alternates, addenda, and modifications preceding this Specification Division are applicable to Plumbing Contractor and his subcontractors and material suppliers.

22-2 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) When a word such as “proper,” “satisfactory,” “equivalent,” and “as directed” is used, it requires Engineer’s review.

c) “Provide” means furnish and install.

d) “Working Day” wherever used in these Specifications, shall mean the normal working days Monday through Friday, exclusive of Saturday, Sunday, and federally observed holidays.

e) Architect/Engineer hereinafter abbreviated A/E shall mean both the Design Architects and the Design Engineers.

f) Design Engineer hereinafter abbreviated D/E shall mean the engineering firm, RTM Engineering Consultants, 3333 E. Battlefield, Suite 1000, Springfield, MO 65804, Telephone (417) 881-0020. Contact Person: Tyler Enserro.

g) General Contractor hereinafter abbreviated G/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the general division work.

h) Electrical Contractor hereinafter abbreviated E/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the electrical division work.

i) Plumbing Contractor hereinafter abbreviated M/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the mechanical division work.

j) Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred to.

22-3 GENERAL EXTENT OF WORK:

a) Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory for proper operation and completion of mechanical systems. In no case will claims for “Extra Work” be allowed for work about which M/C could have informed himself before bids were taken.

b) M/C shall familiarize himself with equipment provided by other contractors, which require mechanical connections and controls.

22-4 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.

22-5 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 (AHJ).

b) Conform to latest editions and supplements of the following codes, standards, or recommended practices as adopted by the AHJ.

1. CITY CODES:

   A. 2012 International Plumbing Code.

   B. 2012 International Mechanical Code.

   C. 2012 International Building Code.

   D. 2012 International Fire 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 Standards Institute ANSI A117.1.

3. NATIONAL FIRE CODES:

   A. NFPA 54 Gas Appliance and Gas Piping Code.

   B. NFPA 70 National Electric Code – 2014 Edition.

   C. NFPA 89M Clearances, Heat Producing Appliances.

   D. NFPA 90A Air Conditioning and Ventilation Systems.

   E. NFPA 91 Blower and Exhaust Systems.

   F. NFPA 101 Life Safety Code – 2012 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, 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 A/E for approval.

e) M/C 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 (2) copies to A/E with request for final inspection.

22-6 CONTRACT CHANGE:

a) Changes or deviations from contract; including those for extra or additional work must be submitted in writing for review of A/E. 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 adjustment factors. If proposals are not itemized, they will be rejected and returned for proper submittal.

d) The maximum allowable profit for any change order shall be ten percent (10%).

e) See Example below:

PRICING SHEET

Project:	Boiler Room Repairs for ABC Company			Date:	Jan 1, 2021
Location:	Springfield, Missouri			Estimator:	Jane Doe
Labor Rate:	$22.00				

Material	Units	Unit Measure	Material Per Unit	Man Hours Per Unit	Total Man Hours	Material Total
6” tee	1	ea.	$45.00	2.000	2.0	$ 45.00
Less 6” ell	1	ea.	$30.00	0.000	0.0	$ 30.00
6” sch 40 pipe	22	ft.	$10.43	0.253	3.8	$ 56.46
6” cap	1	ea.	$11.00	1.500	1.5	$ 11.00
6” hanger	1	ea.	$12.00	0.400	0.4	$ 12.00
4” saddle weld	1	ea.	$0.00	1.200	1.2	$ 0.00
4” sch 40	18	ft.	$4.44	0.183	3.3	$ 79.92
4” ell	3	ea.	$13.39	2.000	6.0	$ 40.17
4” hanger	3	ea.	$8.00	0.300	0.9	$ 24.00
4” weld	1	ea.	$3.00	1.000	1.0	$ 3.00
1.5” cond sch 80	21	ft.	$1.63	0.080	1.7	$ 34.23
1.5” ell	3	ea.	$4.00	0.400	1.2	$ 12.00
1.5” tee	1	ea.	$5.00	0.600	0.6	$ 5.00
1.5” weld	1	ea.	$3.00	0.400	0.4	$ 3.00
0.75” F & T trap	1	ea.	$73.00	0.500	0.5	$ 73.00
0.75” strainer	1	ea.	$12.00	0.500	0.5	$ 12.00
0.75” XH nipples	4	ea.	$7.70	0.100	0.4	$ 30.80
0.75” unions	2	ea.	$3.18	0.300	0.6	$ 6.36
0.75” cap	1	ea.	$0.65	0.100	0.1	$ 0.65
0.75” pipe sch 80	10	ft.	$0.72	0.400	0.4	$ 7.20
0.75” tee	1	ea.	$1.50	0.300	0.3	$ 1.50
0.75” ell	3	ea.	$0.95	0.200	0.6	$ 2.85
0.75” hanger	2	ea.	$2.50	0.200	0.4	$ 5.00

SUBTOTAL					28.74	$618.47
SALES TAX				6.125%		$37.88
LABOR	28.4	MH	$22.00			$624.80
5% OVERHEAD						$64.06
8% PROFIT						$107.62
TOTAL						$1,452.83

22-7 LOCATIONS AND INTERFERENCES:

a) Locations of equipment, piping, and other mechanical work are 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 A/E.

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 A/E 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 the 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 is found in error.

22-8 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 and all required programming installed under this Specification.

b) Contractor shall be responsible for all work as required by phasing of construction for intended use by the owner as applicable.

22-9 WARRANTY:

a) M/C 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 (1) year from and after date of substantial completion of building and acceptance of mechanical systems by Owner.

b) Where manufacturers' warranties expire during the one (1) year warranty period, one (1) year warranty period is defined as year after date of substantial completion. M/C shall include provisions for extending warranty for the full one (1) year period and shall cost for warranty extension in his base bid.

c) M/C warrants to Owner and Architect that on receipt of written notice from either of them within one (1) 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 M/C's expense.

d) The above warranty shall not supersede any separately stated warranty or other requirements by law or by these Specifications.

e) If the Architect's specification includes a warranty that exceeds the above warranty requirements, the Architect's warranty shall take precedence.

22-10 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS:

a) The intent of these Specifications is to allow ample opportunity for M/C 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.

b) Material and equipment installed under this contract shall be first class quality, new, unused, and without damage.

c) 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 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 M/C'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 D/E.

d) 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 A/E for review prior to procurement.

e) **PRIOR TO RECEIPT OF BIDS, IF M/C WISHES TO INCORPORATE PRODUCTS OTHER THAN THOSE NAMED IN SPECIFICATIONS IN HIS BASE BID, HE SHALL SUBMIT A WRITTEN REQUEST FOR REVIEW OF SUBSTITUTIONS TO D/E NOT LESS THAN SEVEN (7) WORKING DAYS PRIOR TO BID TIME. D/E WILL REVIEW REQUESTS AND ACCEPTABLE ITEMS WILL BE LISTED IN AN ADDENDUM ISSUED TO PRINCIPAL BIDDERS.**

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 A/E, 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 (2) copies of complete descriptive and technical data including E/M's name, model, and catalog number, photographs or cuts, physical dimensions, operating characteristics, and any other information needed for comparison.

g) 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 are under this contract or under separate contracts.

h) Within seven (7) working days after bids are received, apparent lower bidder shall submit to A/E for approval three (3) 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, M/C shall submit shop drawings for equipment and materials to be incorporated in work, for A/E review. Where 30 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, M/C 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.

i) After execution of contract, substitution of product brands for those named in Specifications will be considered, only if; 1) request is received within 30 days after contract date and request includes statement showing credit due Owner, if any, if substitution products are used, or 2) Owner requests consideration be given to substitute brands.

22-11 SHOP DRAWINGS, OPERATION, AND MAINTENANCE INSTRUCTION:

a) Unless noted differently in the general requirements of the specifications, M/C shall furnish a minimum of six (6) sets of shop drawings of all materials and equipment, Engineer will retain one (1) set.

b) 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, or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear E/M's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

c) M/C shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the A/E for their review. All shop drawings submitted to A/E shall bear M/C approval stamp which shall indicate that M/C has reviewed submittals and that they meet Specification and/or drawing requirements. M/C's submittal review shall specifically check for, but not 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 M/C's approval shall be returned to his supplier for resubmittal.

d) No shop drawing submittals will be considered for review by the A/E without M/C's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review. All comments or minor notations on shop drawings shall be flagged as follows to indicate originator of comment or notation: 1 Contractor, 2 Construction Manager, 3 Architect, and 4 Engineer.

e) A/E will not be responsible for the cost of returning shop drawing submittals that are submitted to them without M/C's review and approval stamp. A letter will be sent to M/C by either the Architect or Engineer indicating receipt of an improper submittal. M/C shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. A/E will hold improper submittals for pick-up by M/C or supplier for 22 working days after date of receipt. If not picked up by the 16th working day, submittals will be disposed of by A/E.

f) A/E's review of shop drawings will not relieve M/C of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing to Owner or his representative, nor shall it relieve M/C of responsibility for errors in shop drawings. No work shall be fabricated until A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be M/C's responsibility.

a) Operating and Maintenance Instructions:

1. Submit with shop drawings of equipment: copies of installation, operating, maintenance instructions, and parts list for equipment provided. Instructions shall be prepared by E/M.

2. Keep in safe place keys and wrenches furnished with equipment under this contract. Present to Owner and obtain a receipt for same upon completion of project.

3. Contractor shall provide all final documents including drawings, shop drawings, etc. in PDF format on a single disk to Owner. A total of five (5) CD's shall be provided, three (3) to the Owner and two (2) to A/E. No exceptions will be allowed to this requirement. Videotaping, as specified in other parts of this Specification, will also be required at closeout.

22-12 PROPOSED VALUE ENGINEERING/PROJECT SCOPE REVISIONS:

a) Where design revisions are requested/required based on value-engineering or proposed changes in project scope, the contractor shall include in his proposed cost savings or adds the necessary MEP

design fees that are required for modifying construction documents and associated meetings. To determine that value to be included, the contractor shall submit to the A/E the proposed scope of the work required for the changes at least 7 days prior to required pricing submittal so that the design fees can be accurately determined and included. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

b) Where the contractor proposes to use different equipment that results in significant difference in routing or space considerations than shown in the construction documents, the contractor shall include the necessary MEP design fees that are required for modifying or creating construction drawings necessary either for construction or submission to the authority having jurisdiction and required for additional review. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

22-13 CAD/BIM FILE REQUESTS:

a) CAD files and/or BIM models (only where created as part of the project design) are the property of the D/E and are only available upon documented written request. Prior to receiving any CAD files or models, the contractor shall submit a drawing cost fee of $50/drawing up to a maximum $1500 (BIM models are $1500). In addition, the contractor must sign a Third Party User Agreement and Drawing Request Form which must be forwarded to the D/E office prior to any CAD files being released. This form is available from the D/E upon request.

22-14 CUTTING AND PATCHING:

a) M/C 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.

22-15 MUTILATION:

a) Mutilation of building finishes, caused by installation of mechanical equipment, fixtures, piping, and other mechanical devices shall be repaired at M/C's expense to approval of Architect.

22-16 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 a minimum of 6", 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 earth or sand and tamp to compaction required by A/E. Mechanically tamp backfill under concrete and paving in 6-inch layers to 95 percent standard density.

d) Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moisten 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 excavation in base bid.

f) Trenches shall be installed to have a bedding of natural or artificial graded fixture of crushed gravel or sand with 100% passing a 1 inch sieve and not more than 8% passing a #200 sieve. All depressions shall be filled with tamped and sand backfill. Place and compact backfill of sub-base material free of particles larger than 1" over piping. Compact each 6" layer at 85% density. Install warning tape directly above piping outside the building at 12" below grade.

g) All buried PVC DWV piping systems shall be installed in accordance with ASTM D 2321. Submit pictures of the underground pipe installation to the design engineer prior to backfilling.

h) Gravel for use of backfill will not be accepted unless approved by Engineer.

i) Notify Engineer two (2) business days prior to plumbing inspection by AHJ so that Engineer can visually inspect piping prior to backfill.

22-17 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 E/M's installation instructions.

c) Provide concrete bases for all floor and slab mounted equipment. Refer to drawings for required base type and size. Provide 3.5-inch high base where base is not shown on drawings.

22-18 START-UP, CHANGE-OVER, TRAINING, AND OPERATIONAL CHECKS:

a) M/C 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 E/M's technicians, when specified, and Owner's operating personnel shall be present during these operations.

22-19 PRE-FINAL AND FINAL CONSTRUCTION REVIEW:

a) At M/C's request, A/E 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 A/E as not complete or not in accordance with requirements of contract will be outlined in report to M/C. After completion and/or correction of these items M/C shall notify Architect he 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 A/E at least ten (10) working days prior to date of final construction review.

c) At final construction review, M/C and his major subcontractors shall be present or shall be represented by a person of authority. Each contractor shall demonstrate, as directed by A/E, that his 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.

22-20 PAINTING OF MATERIALS AND EQUIPMENT:

a) Equipment and materials exposed to interior dry environment shall have a minimum of one (1) primer and one (1) finish coat. Equipment and materials mounted in exterior location shall have a minimum of one (1) primer and two (2) finish coats with total thickness of at least 5 mils. Finish coat colors in finish areas shall be as selected by A/E.

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. A/E will make final determination of extent of refinishing required.

d) Paint all exterior gas piping with one (1) primer coat and two (2) finish coats.

22-21 MAINTENANCE OF SYSTEMS:

a) M/C shall be responsible for operation, maintenance, and lubrication of equipment installed under his contract.

22-22 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 tests indicate non spore-forming bacteria have been destroyed or for 24 hours, whichever is greater.

b) All points in system shall have at least 10 ppm of solution at end of retention period.

c) When time and concentration 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 value in system six (6) times during flushing operation.

d) Test samples taken from several points in system shall indicate absence of pollution for 48 hours. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

22-23 PIPING IDENTIFICATION:

a) Identify piping in mechanical rooms, above ceilings, 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 bank of identification color around circumference of pipe in lieu of painting complete pipe or pipe covering.

d) 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.

e) See 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
Roof Drain	Roof Drain	Green	White
Natural Gas	Natural Gas	Yellow	Black
Fire Protection Water	Fire Protection Water	Red	White
Fire Sprinkler Water	Fire Sprinkler Water	Red	White

22-24 VALVE IDENTIFICATION:

a) Mark all valves located above ceiling with designation on ceiling tile directly below the valve as directed by the owner.

22-25 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. Sleeves shall not be provided in rated floors requiring fire seals.

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 through pipe sleeves with 0.25-inch minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through 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 0.375-inch-wide band. Provide Kaowool fire master bulk packing between sleeve and metal jacket. 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.

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.

22-26 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 AWS B3.0 and ANSI Z49.1.

b) Welding shall be done only be 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 (3) copies of a list of welders who will work on project listing welder's code, date, and types of latest qualification tests passed by each welder.

c) Welded joints shall be fusion welded in accordance with Level AR3 of 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.

22-27 PIPING MATERIALS AND FITTINGS:

a) Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturer's name and weight. All materials listed may not be required on this project. See piping material schedules, on drawings, for materials to be used for each piping system. Piping materials shall be as follows:

1. Cast Iron Pressure Pipe:

   A. Pipe and fitting shall be mechanical joint cast iron pipe centrifugally cast in metal molds coated inside and out with coal tar varnish to latest ANSI A21.6

   B. Joints shall be mechanical, bolted stuffing box type with plain rubber gasket conforming to latest ANSI A21.11.

2. 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 CISPI 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, Central Foundry, or Wheatland Tube Company.

   D. All cast iron soil pipe and fittings shall be marked with the Collective Trademark of CISPI and be listed by NSF International.

3. Carbon Steel Pipe (0.5 inches through 2.5 inches):

   A. Provide continuous weld or electric resistance welded carbon steel pipe conforming to ASTM A120 or A53, as scheduled.

   B. Pipe joints shall be threaded conforming to ANSI B2.1, beveled for welding, or grooved for use with Victaulic couplings.

   C. Pipe by Armco, Youngstown, United States Steel, or equal.

4. Carbon Steel Pipe (3 inches and above):

   A. Provide seamless continuous or electric weld carbon steel pipe conforming to ASTM A120 or A53, as scheduled.

   B. Pipe ends shall be beveled for welding or grooved for use with Victaulic couplings.

   C. Pipe by Armco, Youngstown, United States Steel, or equal.

5. Polyvinyl Chloride (PVC) Pipe:

   A. Provide Type 1, Grade 1 PVC pipe conforming to requirements of current ASTM D 1785 for pressure piping as scheduled. Pipe shall be approved by NSF for potable water.

B. Provide Type 1, Grade 1 PVC pipe conforming to requirements of current ASTM D 2665 for DWV piping as scheduled. Cellular core PVC piping will not be approved.

C. Piping for pressure piping shall have plain ends for socket type fittings.

D. Pipe by Chemtrol, Charlotte, Tyler, Pipelife, Cabot, or equal.

6. Copper Tube:

A. Provide hard temper copper water tube conforming to requirements of current ASTM 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.

22-28 PIPE FITTINGS:

a) Pipe 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 B16.9 and ASTM A234.

B. Fittings by Grinnell, Midwest, or equal.

2. Branch Connection Welding Fittings:

A. Provide carbon steel weldolet fittings conforming to ANSI B16.9, B16.11, B31.1.0, and ASTM A105, Grade 11.

B. Fittings by Bonney Forge or equal.

3. Branch Connection Welding to Screwed Fitting:

A. Provide carbon steel threadolet fitting conforming to ANSI B16.9, B16.1.1, B31.1, and ASTM A105, Grade 11.

B. Fittings by Bonney Forge or equal.

4. Carbon Steel Flanges:

A. Provide carbon steel flanges conforming to ASTM A 181, Grade 1 and ANSI B16.5

B. Flanges by Grinnell, Midwest, or equal.

8. Ductile Iron Grooved Fittings:

A. Provide grooved end fittings shall cast of ductile iron conforming to ASTM Specification A536 grade 65-45-12 or wrought steel conforming to ASTM A234 grade WPB, or factory fabricated from carbon steel pipe conforming to ASTM A53 grade B.

B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. Fittings by Victaulic Company or “Gruvagrip” by Gustin-Bacon.

9. Wrought Copper Fittings:

A. Provide wrought solder joint copper tube fitting conforming to ANSI B16.22.

B. Fittings by Chase, Nibco, or equal.

10. 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.

11. PVC, Schedule 40 Pressure Fittings:

A. Provide NSF rated, Schedule 40, PVC socket fittings conforming to ASTM D 2466.

B. Solvent cement of socket fittings shall conform to ASTM D 2564.

C. Fittings by Tyler, Charlotte, or equal.

12. Pipe Flange Gaskets:

A. Gaskets by Durable Manufacturing Co., Garlock Co., or equal.

22-29 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. Steel pipe to steel pipe screwed end:

A. Provide Stockham malleable iron No. 693-0.5 insulating union with high dielectric strength insulating sleeve and gasket.

2. Steel pipe to steel pipe flanged end:

A. Provide two (2) weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.

3. 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 deg F. Equal by Capitol Manufacturing, Central Plastics and Watts Regulator.

B. Dielectric nipples shall not be used.

22-30 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.

    1. General: Provide Zurn “Y” Type with 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.

b) Equivalent strainers by Armstrong, Metraflex, Trane, Nibco, Victaulic, Dunham Bush, Musseco, Paget, or Spirax Sarco.

22-31 UNIONS:

a) Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.

b) Provide Stockham brass seat unions of material and pressure rating required by piping system.

c) Where piping systems of dissimilar materials are jointed together, provide proper insulating union as specified under this Specification.

22-32 BACKFLOW PREVENTERS:

a) Provide where indicated on plans for valves 2” and smaller a Watts Model LF007 double-check backflow preventer with strainer and ball valves. Equal by Febco, Hershey, Ames, or Wilkins will be acceptable.

b) Provide where indicated on plans for valves 2.5” and larger a Watts Model LF709 double-check backflow preventer with strainer and ball valves (2.5 inches) and butterfly valves (larger than 2.5 inches). Equal by Febco, Hershey, Ames, or Wilkins will be acceptable.

c) Provide where indicated on plans for valves 2” and smaller a Watts Model LF009 reduced-pressure, backflow preventer with strainer, drip cup, and ball valves. Equal by Febco, Hershey, Ames, or Wilkins will be acceptable.

d) Provide where indicated on plans for valves 2.5” and larger a Watts Model LF909 reduced-pressure, backflow preventer with strainer, drip cup, and ball valves (2.5 inches) or butterfly valves (over 2.5 inches). Equal by Febco, Hershey, Ames, or Wilkins will be acceptable.

e) Provide on all water connections to kitchen, equipment, and faucets a Watts SD-3 dual check, backflow preventer with atmospheric vent and drain routed to nearest floor drain or sink. Equal by Febco, Hershey, Ames, or Wilkins will be acceptable.

22-33 PIPING INSTALLATION:

a) Piping systems materials and installation shall conform to the following standards and codes:

    1. System: Natural Gas Piping Code: ANSI Standard B31.2 "Fuel Gas Piping"

    2. System: Plumbing System Piping Code: International Association of Plumbing and Mechanical Officials "Uniform Plumbing Code"

b) 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. In no case shall piping smaller than size specified be used.

c) 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 manufacturer's 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 manufacturer's recommendations for fixed hanger and supports. Provide copper plated hangers and supports for suspension of un-insulated copper tubing lines.

d) Provide escutcheon plates on all piping penetrations of exposed walls. Paint to match exposed surface.

e) Install all piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping systems. 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.

f) Provide piping materials and wall thickness for specific piping systems as listed in piping schedules in Section 22. Steel piping systems 2.5 inches and under shall be threaded pipe fittings. Steel pipe systems 3 inches and above shall be welded end pipe and fittings unless required otherwise by Code.

g) Where listed in piping schedules or noted on drawings, provide 2 inches and larger with Victaulic grooved couplings as specified.

h) 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.

i) 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 mitered or field fabricated pipe fittings will be permitted.

j) All pipe threads shall meet ANSI 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.

k) 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.

l) 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.

m) Soft soldered socket type joints shall be made with 95-5 tin-antimony solder as required by temperature and pressure rating of piping systems. Solder 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.

n) Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings suitable for at least 125 psi working pressure or of pressure rating required for maximum working pressure of system, whichever is greater.

o) Where pipe sizes of header or branch water supply piping do not appear on drawings, size piping to plumbing fixtures as follows:

FIXTURE TYPE	MAXIMUM QUANTITY OF FIXTURES	PIPE SIZE CW	PIPE SIZE HW
Water Closet (Flush Valve)	1	1.25”	--
Water Closet (Flush Valve)	2	1.5”	--
Water Closet (Flush Valve)	5	2”	--
Water Closet (Flush Valve)	10	2.5”	--
Lavatory	1	0.5”	0.5”
Lavatory	3	0.75”	0.75”
Lavatory	6	1”	1”

22-34 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. For application of specific valve types see Section 22 of this Specification.

b) Valves 2.5 inches and smaller 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 2 feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3 inches and over shall have flange end connections or butt weld ends as scheduled. Optional Victaulic grooved valves may be used where scheduled.

c) Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance.

d) Non-rising stem valves shall not be installed at any point in the piping systems. With permission of A/E, non-rising stem valves may be installed at particular points where space is restricted.

e) 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.

f) Valves shall be the same size as piping shown on drawings. Do not reduce valve size.

g) Equivalent gate, butterfly, globe, and plug valves listed on current comparison charts of specified valve manufactured by Crane, Centerline, NIBCO, Kennedy, Keystone, Powell, or Victaulic will be acceptable.

h) Equivalent balancing valves by Taco, Flowset, Thrush, or Illinois will be acceptable.

i) Equivalent globe style silent check valves listed on current comparison charts of specified valve manufactured by NIBCO F-910-B or equal by Combination Pump Valve Co., Pagent, or Williams will be acceptable.

j) Equivalent automatic flow control valves by Flow Design, Hays Fluid Control, Griswold and Siemens.

22-35 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	2.5-inch valves and smaller for domestic water: Apollo Series 77CLF-X40, bronze (MSS SP-110, IAPMO IGC-157 or NSF/ANSI 61-8) (lead-free) full port ball valve 600 psi-WOB, Teflon seats, 316 stainless steel ball and stem with insulated handle and soldered, grooved or screwed ends. Provide stem extension for handle as required for insulation of valve body.
BLV-3	1-inch valves and smaller for gas: Apollo Series 77G-UL, bronze (MSS SP-110, UL-MHKZ, YSDT and YRBX Listed) full port ball valve 600 psi-WOB, multi-fill PTFE seats and seals, brass ball, stem with insulated handle with screwed ends.

Butterfly valves shall be scheduled as Type “BFV” valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
BFV-1	2.5-inch valves through 6-inch valves: NIBCO Series LD-2000-3 ductile iron full lug body, lever operator, 8-inch and larger shall have enclosed weather proof gear operators NIBCO LD-200-5 200 pound aluminum bronze disc, Type 416 stainless steel stem and EPDM molded in liner. All butterfly valves shall be suitable for bidirectional dead-end service without the need for a downstream flange. Use lug body valves NIBCO LD-2000 adjacent to all equipment.

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-inch valves and smaller: Hays 7400 Series iron body gas cock, 175 psi-WOG bronze plug washer and nut, screwed ends.
PLV-2	1.25-inch valves through 2.5-inch 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.

c) Balancing valves shall be scheduled as Type “BAV” valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
BAV-1	4-inch valves and smaller: Bell and Gossett Model CB circuit setter balance valve, bronze body, 125 psi-WP at 250 deg F precision machined orifice calibrated position indicator, meter connections with built-in check valves flanged. Provide complete with polyurethane insulation cover.

d) Silent check valves shall be scheduled as Type “SCV” valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
SCV-1	2-inch valves and smaller: NIBCO T-480-Y bronze check valve, 250 psi-WOG, stainless steel spring, stainless steel stem, Teflon disc and seat ring, screwed or solder ends.

SVC-3	2.5-inch valves and larger: NIBCO style F-910 ANSI Class 125 iron body, bronze trim and stainless-steel spring non-slam check valve, 125 psi-ASA with flanged ends.

e) Automatic flow control valves shall be scheduled as Type “AFV” valves. Valve specifications by type number shall be as follows:

TYPE NO.	SPECIFICATION
AFV-1	2-inch valves and smaller: Flow Design Inc. AutoFlow, Model AC automatic flow control valve, brass body, 400 psi-WP at 250 deg F with electroless nickel and steel wear surfaces with stainless steel spring, built-in strainer, pressure/temperature ports, and shut-off valve with Teflon packing. Provide complete with polyurethane insulation cover.
AFV-2	3-inch valves through 6-inch valves: Flow Design Inc. AutoFlow, Model WS automatic flow control valve, ductile iron body, 600 psi-WP at 250 deg F with electroless nickel and steel wear surfaces with stainless steel spring, and pressure/temperature ports.

22-36 PIPE HANGERS AND SUPPORTS:

a) 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 MSS SP-58.

b) 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 inducted into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

c) Factory made hangers, attachments and supports to be by Tolco, ZSI, or Anvil and must be installed per manufacturer’s requirements. All other hangers, attachments and supports must be approved by A/E prior to installation.

d) Hangers, strut, clamps and supports located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. If located in a corrosive area, hangers, strut and clamps shall be type 304 (316) stainless steel with stainless steel hardware.

e) Clamps on all cold and hot water piping shall be fully insulated equal to an Anvil Cush-A-Therm. Cushioned or bare clamps that are not fully insulated are not allowed. Insulation material and thickness shall match specified material.

f) 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 support pipe.

g) 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.

h) Hangers in direct contact with copper pipe or tubing shall be copper or plated coated with copper-colored epoxy paint.

i) Unless indicated otherwise on drawings, support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
0.5” to 0.75”	0.375”	6’
1” to 1.25”	0.375”	8’
1.5”	0.375”	9’
2”	0.375”	10’
2.5” to 3”	0.5”	12’
4” to 5”	0.625”	14’
6”	0.75”	17’
8”	0.875”	19’
10” to 12”	0.875”	21’

j) Unless indicated otherwise on drawings, support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1”	0.375”	6’
1.25” And 1.5”	0.375”	6’
2”	0.375”	9’
2.5”	0.5”	9’
3” and 4”	0.5”	10’

k) Support horizontal cast iron soil pipe with one hanger for each joint located close to hub.

l) Support plastic piping as recommended by piping manufacturer.

m) 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.

n) Provide continuous thread 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 A/E for review prior to fabrication.

o) Provide Tolco or Anvil pipe hangers for vertical pipe risers per MSS Type 8 or 42:

Type 8: Tolco Fig. 6 or Anvil Fig. 261.
Type 42: Tolco Fig. 14 or Anvil Fig 295.

p) Provide Tolco Fig. 30 steel wall brackets for piping suspended or supported from walls. Brackets shall be carbon steel and selected to meet the load. Finish to be hot dip galvanized in outdoor applications and type 304 (316) stainless steel in corrosive areas.

q) Where hangers are placed outside the jackets of pipe insulation, provide galvanized metal shields. Minimum 12” Long per MSS-SP-58.

r) Mount hangers for insulated piping on outside of pipe, hangers sized to allow for full thickness of pipe insulation. Shield shall support lower 180 degrees of pipe insulation. Omit copper plating on hangers mounted outside insulation on copper tubing.

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
0.5" to 1.5"	12”	18
2" to 6"	12”	18
8" to 10"	18”	16
12" to 18"	24”	14
20" & Larger	24”	12

s) Where roller hangers are required and heat loss must be kept to minimum, use Tolco Fig. 260 – Fig. 265 as required by insulation thickness and pipe size.

t) Structural attachments for pipe hangers shall be as follows:

1. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18. Tolco Fig. 309 or Anvil Fig. 282.

2. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19. Tolco Fig. 68 or Anvil Fig. 94.

3. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 27. Tolco Fig. 336 or Anvil Fig. 14.

4. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21. Tolco Fig. 62 or Anvil Fig. 133.

5. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22. Tolco Fig. 305 or Anvil Fig. 66.

6. For attachment to structural shapes: C-clamps, MSS Type 23. Tolco Fig. 64 or Anvil Fig. 95.

7. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beam clamps, MSS Type 25. Tolco Fig. 335 or Anvil Fig. 217.

8. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut for pipe size 12”and smaller MSS Type 28. Tolco Fig. 62 or Anvil Fig. 133. For pipe size 14” and larger MSS Type 29 Tolco Fig. 297SP or Anvil Fig. 292L

9. Provide Tolco Fig. 506 vibration control hangers at locations on piping to prevent vibrations from being transmitted to building structure by conventional hangers. Apply hangers within their load supporting range and per the following:

   A. All pipe supports on lines that are connected directly to rotating equipment that have no flexible connection between equipment and piping.

   B. All pipe supports within the first 50 lineal feet after a flexible connection to rotating equipment. All supports between the flexible connection and the rotating equipment.

   C. All pipe supports that are attached to piping that is not connected to rotating equipment is exempt from vibration isolation.

u) Provide Anvil International, Inc. 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	0.375” though 4”	PS1100	PS1901
Steel	0.375” through 6”	PS1100	PS1902

v) Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Anvil International, Inc. Fig. 259 or equivalent by Advanced Thermal Systems. Where racks and supports are not detailed on drawings, submit detailed support drawings to A/E for review prior to fabrication.

w) Provide Control Devices HGR Series vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

x) Provide TOLCO fig 318A and 316T combination pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.

y) All piping installed on roofs (except metal roofs) shall be supported by MIRO Industries “Pillow Block Pipe stands.” The base of the stand shall be designed to prevent gouging and ripping the roof membrane. The pipe stands shall be designed to absorb shock and thermal expansion and contraction reducing the friction from pipe movement.

z) Provide Tolco Fig. 20 or Anvil Fig. 262 short strap for attaching pipe tight to ceilings as noted on plans.

aa) 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.

bb) Equivalent hangers and supports by Tolco, Anvil, PHD, Anvil International, Inc., or Fluorcarbon Company.

22-37 CONCRETE INSERTS AND ANCHORS:

a) Provide concrete inserts for attaching piping and equipment as follows:

1. In new construction where attachment points can be predetermined, provide PHD Fig. 950 continuous concrete insert of Fig. 950N Universal Steel Concrete insert.

2. In existing construction or new construction where attachment points cannot be located before setting concrete forms, provide McCullock Kwik-Bolt or Phillips red head concrete anchors of proper type for attachments.

22-38 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 cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as 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 are pressures shall be as follows:

1. Hydrostatic Test (Closed System):

A. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for systems or 220 percent of operating pressure where not specified.

2. Hydrostatic Test (Open System):

A. Test entire system with 10 feet of head 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

head water. Water shall be held in system for 22 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 220 percent of operating pressure, 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 (5) copies of 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.

22-39 PIPING PROTECTIVE COATING:

a) Provide pipe lines listed in pipe schedule to be coated with Pipe Line Service Company X-Tru-Coat high density polyethylene or polypropylene coating extruded on pipe over a thermal plastic adhesive.

b) Coating shall be a minimum of 25 mils thick over minimum 10 mil thickness of thermal plastic adhesive.

c) 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.

22-40 PIPING AND EQUIPMENT 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 Company, Johns Manville, or Owen/Corning Fiberglass or Aerocel.

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. Treatments 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) 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 degree 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 insulations sections.

f) 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.

g) Where glass is specified in the following insulation methods, provide resin impregnated with open weave glass fabric with 10/20 thread count.

h) Abbreviations for manufacturers of adhesives, mastics, and coating specified shall be C.M. for Chicago Mastic Company and B.F. for Benjamin Foster Company.

i) Provide piping systems scheduled for metal insulation jacket with insulation system type specified except omit factory applied jackets on plastic foam or calcium silicate insulation unless indicated otherwise in schedule. Secure insulation with 1.5-inch-wide pressure sensitive type bands on plastic foam insulation and with galvanized tie wire on calcium silicate insulation system with stucco embossed aluminum vapor barrier metal jacket and matching aluminum fitting covers by Childers Products Co., Harren Metals Inc., or Premetco International. Lay fitting covers 2 inches over adjacent insulation jacket and apply 4-inch butt joint strips secured with stainless steel bands Jacket thickness shall be as scheduled with interior surfaces of metal fitting covers factory or field coated with not less than 10 mil thickness of C.M. No. 16-110 or B.F. No. 30-36 mastic coating. Jacket length shall be 3 or 4 feet applied with longitudinal and circumferential joints sealed with 0.125-inch bead of butyl or elastomeric sealant and lapped 2 inches over adjacent cover. Secure cover on piping 12 inches OD and smaller on 2-inch OD and above piping. Bands shall have thumb seals and be coated on 6-inch centers on piping 6-inches OD and smaller and on 12-inch centers on piping 8 inches and larger. Attach bands on aluminum jackets that cover insulation without vapor barrier jacket with one pop rivet, secure bands on aluminum jackets that cover insulation with vapor barrier jackets by cutting diagonal cut in longitudinal lap adjacent on piping within 6 feet of floor shall be 0.020-inch-thick or double jacket of 0.016-inch thickness.

j) Piping insulation materials and application methods by type shall be as follows:

1. TYPE 2-PC: Insulation for cold surface piping system with minus 50 deg F to plus 220 deg F operating temperature range shall be Armstrong AP Armaflex Elastomeric pipe insulation average thermal conductivity shall not exceed 0.27 BTU/Hr. at 75 deg 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 520 adhesive. Thickness shall be per manufacturer's recommendations using a maximum severity of 90 deg F and 80 percent RA. Insulate fittings as follows:

   A. Insulate exposed and concealed valves 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 520 adhesive. Finish insulation as soon as possible with two coats of Armstrong Armaflex water-based, latex enamel finish in

color selected by Architect. All insulation used outdoors shall be painted to prevent ultra violet deterioration of insulation.

k) Equipment insulation materials and application methods shall be as follows:

1. TYPE 1-EC: Cold surface equipment insulation for external surfaces with plus 35 deg F to plus 220 deg F operating temperature range shall be Armstrong FR/Armaflex pipe or sheet insulation as required with 5.5-inch or 6-pound density. Average thermal conductivity shall not exceed 0.27 BTU/Hr. at 75 deg F mean temperature. Apply insulation directly to metal surfaces and seal insulation joints with Armstrong No. 520. Insulation shall be mitered, beveled, and built up as required to provide a smooth and neat exterior surface. On large pumps and equipment provide joints in insulation at points where equipment casing must be disassembled for maintenance and repair. Insulate these joint areas so that insulation can be easily removed from casing joints without removing or damaging adjacent insulation. Finish insulation with two (2) coats of Armstrong Armaflex vinyl-lacquer finish.

l) Insulation materials and application methods for piping hangers supports, anchors, guides, expansion joints, etc. shall be as follows:

a) Insulate hangers and supports from direct contact with cold surfaces with ITW Trymer Supercel Phenolic inserts or equal of half or full sections of pre-molded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2 inches over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degree 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. Materials shall meet the ASTM E84 burn characteristics of 25/50.

1. Insulate pipe anchors in direct contact with cold piping for a distance of 12 inches or as detailed on drawings form 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.

2. Insulate pipe guides from direct contact with cold surfaces piping with Styrofoam HD-300 plastic foam full section inserts of pre-molded pipe insulation equal in thickness to adjoining pipe insulation. Provide inserts with vapor barrier jacket for overlapping 2 inches 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.

3. Insulate pipe expansion joints on cold surface piping with over-sized section of pre-molded 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.

4. Where piping hanger cannot be isolated from cold pipe surfaces, insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to a point 12 inches 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.

5. Insulate floor supports in direct contact with cold surface piping with Armstrong 0.5-inch-thick Armstrong FR/Armaflex pipe or sheet insulation as required by surface. Insulate supports from pipe to floor plate and seal insulation joints with Armstrong No. 520. Finish insulation with Armstrong Armaflex vinyl-lacquer finish.

6. All pipe insulation shall be continuous through walls, ceiling, or floor openings or sleeves except where firestop or firesafing materials are required.

b) Insulation of removable heads and valves, manhole access covers, 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.

c) 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 (1) year after date of final acceptance or through one (1) heating season and one (1) 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 M/C's expense at no cost to Owner.

22-41 ELECTRICAL REQUIREMENTS:

a) Consult Section 26 of electrical Specifications for work to be provided by E/C 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 26 shall be included in M/C'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 Section 22-10g of Specifications shall be paid by M/C at no cost to owner or A/E.

d) M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking, and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

e) Furnish six (6) complete sets of electrical wiring diagrams to A/E and three (3) complete sets to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.

f) M/C shall obtain complete electrical data on mechanical shop drawings and shall list this data on approval form which shall be presented monthly, or on request, to E/C. 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, and locked current to allow E/C to order electrical equipment required in his contract.

g) Safety-disconnect switches and manual and magnetic motor starters shall be provided by E/C. Exceptions will be allowed where mechanical equipment is specified with these devices installed as part of factory built control systems.

22-42 RECORD DOCUMENTS:

a) 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 sheers into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on cover of each sheet.

b) 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:

1. Piping.

2. Conduits.

c) The Contractor shall provide the photographs in an 8.5-inch by 11-inch format for record keeping purposes with the maintenance manuals. The photos shall all be digital and a disk or CD shall be provided to the Owner as a permanent record.

d) 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.

22-43 PIPING SYSTEMS MATERIALS:

a) Refer to Section 22 of this specification for piping material specifications and installation instructions.

b) See schedule for specific piping materials and joining methods for systems installed under this section.

22-44 PIPING SYSTEMS VALVES:

a) Refer to Section 22 of this specification for valve type specifications and installation instructions.

b) See schedule for valve types to be installed under this section.

Service	Size	Stop	Check	Balance
Domestic Water	Up to 2.5"	BLV-1	--	--
Domestic Water	Up to 2"	--	SCV-1	--
Domestic Water	3" to 8"	BFV-1	--	--
Domestic Water	2.5" & Up	--	SCV-3	--
Domestic Water	Up to 4"	--	--	BAV-1
Natural Gas	Up to 1"	PLV-1/BLV-3	--	--
Natural Gas	1.25" to 2.5"	PLV-2	--	--

22-45 PIPING SYSTEM INSULATION:

a) Refer to Section 22 for insulation type specifications and installation instructions.

b) See schedule for insulation types and thickness for piping installed under this section.

Service	Size	Type	Thickness
Domestic Cold Water	All	2-PC	0.5"
Domestic Hot Water	Up to 1.25"	2-PC	1"
Domestic Hot Water	1.5" & Up	2-PC	1.5"
Domestic Cold Water below Grade	All	2-PC	0.5"
Domestic Hot Water below Grade	Up to 1.25"	2-PC	1"
Domestic Hot Water Return	Up to 1.25"	2-PC	1"
Domestic Hot Water Return	1.5" & Up	2-PC	1.5"

22-46 EQUIPMENT INSULATION:

a) Refer to Section 22 for equipment insulation specifications and installation instructions.

b) See schedule for insulation for equipment to be insulated under this section.

EQUIPMENT INSULATION SCHEDULE

Equipment	Type	Thickness
Pump Casing	1-EC	1”
Compression Tank	1-EC	1”

22-47 SCHEDULE OF FIXTURE BRANCHES:

a) Connection to individual plumbing fixtures shall be as follows:

Item	Waste	Vent	Cold	Hot
Urinal	2”	1.5”	1”	--
Water Closet – Flush Valve	4”	2”	1.25”	--
Water Closet – Flush Tank	4”	2”	0.5”	--
Lavatory	2”	1.25”	0.5”	0.5”
Drinking Fountain	2”	1.25”	0.5”	--
Janitor Basin	3”	1.5”	0.5”	0.5”
Shower	2”	1.5”	0.5”	0.5”
Sink	2”	1.5”	0.5”	0.5”

22-48 ADJUSTMENT AND BALANCING:

a) Adjust flush valves to minimum volume and balance flow in hot water returns as required to maintain proper water temperature in all branches circulated.

22-49 DRAINS, FLOOR SINKS, DOWNSPOUT NOZZLES, ETC.:

a) Floor Drains: Block out floor prior to pouring of concrete and then level floor drain after pour is set, remove forms, and grout level:

   1. Refer to schedules on plans for make and model required.

   2. All floor drains in finished areas shall have nickel-bronze strainers except at showers where they shall be chrome-plated strainers.

   3. Provide each drain that does not have an integral “P” trap with a cast iron “P” trap in connecting piping.

   4. See Architectural plans for floor drain top elevations and floor drainage.

   5. Floor drains shall be as manufactured by Wade, Josam, Watts or Zurn.

   6. Sioux Chief shall be allowed on PVC piping systems only.

b) Floor Sinks: Block out floor prior to pouring of concrete and then level floor sink after pour is set, remove forms, and grout level.

   1. Refer to schedules on plans for make and model required.

   2. Floor sinks shall be as manufactured by Wade, Josam, Watts, or Zurn.

c) Trap Seal Primers:

   1. Provide waterless, inline trap seal protection with UV resistant frame and silicone sealing ribs.

22-50 CLEANOUTS:

a) Provide cleanouts full size of soil pipe up to and including 4-inch ID. Provide cleanouts at base of stacks, end of sewer main, and at elbows over 45 degrees and in any horizontal run of piping exceeding 100 feet at 50-foot intervals. Block out floor prior to pouring of concrete and then level cleanout after pour is set, remove forms, and grout level. Install cleanouts so they are accessible by extending them through walls, floors, and above or to outside of building, as required. Cleanouts shall be as follows:

b) Wall Type Finished Areas: J.R. Smith No. 4532 cast iron cleanout “T” with cleanout plug and stainless steel access cover.

c) Wall Type Unfinished Areas: J.R. Smith No. 4512 cast iron cleanout “T” with countersunk plug.

d) Floor Type Hard Flooring Areas: J.R. Smith 4023 with round chrome plated scoriated cover.

e) Floor Type Carpet Areas: J.R. Smith 4023-X with nickel bronze top and carpet clamp.

f) Floor Type Carpet Areas: J.R. Smith 4023-Y with nickel bronze top and carpet marker.

g) Finish Grade Cleanout: J.R. Smith 4223 cast iron with extra duty cast iron top. Install in 18x18x7 concrete pad with #3 rebar and chamfered edges.

h) Equivalent cleanouts by Wade, Watts, Zurn, Josam or Jonespec will be acceptable.

i) Verify floor materials used from Architectural plans.

22-51 HYDRANTS AND HOSE BIBBS:

a) Wall Hydrants: Woodford No. 67 freeze proof with vacuum breaker equivalent by Prier, Wade, Zurn, or J.R. Smith will be acceptable.

b) Hose Bibbs: Woodford Model 24P-3/4 or equal angle hose bibb with Midel Model 34HF vacuum breaker and loose tee handle.

c) Freeze Proof Roof Hydrant: MAPA Products Model MPH-24FP pedestal hydrant with stainless steel shroud, roof deck support, built-in vacuum breaker, weather-guard dome handle, and stainless steel reservoir. Units shall be insulated with R-8 thermo-cell insulation.

22-52 SHOCK ABSORBERS:

a) Provide Josam Absorbotron shock absorbers, or approved equal, on all plumbing fixture batteries where shown on plans sized in accordance with the Plumbing and Drainage Institute Standards PDI WH201. Equivalent shock absorbers by Zurn, Wade, Sioux Chief, or J.R. Smith will be acceptable.

b) Provide J.R. Smith Model 5060 “Hy-Duty” shock absorbers on each cold and hot water branch piping serving commercial washer/extractors. Equivalent shock absorbers by Zurn, Wade, Sioux Chief, or Josam will be acceptable.

22-53 PLUMBING FIXTURES:

a) Provide plumbing fixtures as shown on drawings 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 stub outs to stops under lavatories, provided deep escutcheons are used and no copper is visible in lieu of chrome nipples.

c) Equivalent fixtures and accessories by the following manufacturers will be acceptable:

1. Fixtures: American Standard, Eljer, Kohler, Toto, Crane, or Zurn.

2. Toilet Seats: Church, Olsonite, Toto, Bemis, American Standard, Kohler or Beneke.

3. Fittings, Carriers, and Supports: Josam, J.R. Smith, Zurn, or Wade.

4. Faucets: Sloan, Zurn, Toto, American Standard, Kohler, Delta, Chicago Faucets, or Moen.

5. Flush Valves: Sloan, Zurn, Delany, Toto or American Standard.

6. Traps, Supplies, and Stops: Dearborn, Sanitary Dash, BrassCraft, or as specified under plumbing fixtures:

   A. Lavatory Supplies and Stops: McGuire LF170, 0.5-inch compression inlet with angle compression stop and 0.375-inch OD risers in length required. Provide deep chrome plated brass escutcheons.

   B. Water Closet Supplies and Stops: McGuire LF187, 0.5-inch compression inlet with angle compression stop and 0.5-inch OD risers in length required. Provide deep chrome plated brass escutcheons.

   C. Traps: McGuire 8912C (1.5-inch) and/or 8872C (1.25-inch) cast brass body with cleanout “P” trap. Provide deep chrome plated brass escutcheon with set screw. Provide offset tailpieces as required for ADA compliance.

7. See Schedule for fixture type to be installed under this section.

d) Refer to architectural plans for exact locations and elevations of all plumbing fixtures. Trip levers on all ADA water closets shall be opposite the grab bar installed beside the water closet.

22-54 WATER HEATER:

a) Provide water heaters as specified below and as indicated on construction drawings.

b) Water heaters shall meet ASHRAE 90A-1 980 and shall be ASME rated.

c) Gas water heaters shall be CSA certified.

d) Equivalent by National, Lochinvar, Bradford White, Ruud, Rheem, A.O. Smith, or State will be acceptable.

22-55 IN-LINE PUMPS:

a) Provide in-line pumps with capacities as shown on plans. Pumps shall be in-line type, close-coupled, single-stage design, for installation in vertical or horizontal position, and capable of being serviced without disturbing piping connections.

b) Pump casing shall be of Class 30 cast iron or as specified. The impeller shall be of cast iron bronze, enclosed type, dynamically balanced, keyed to the shaft, and secure by a locking cap screw. All domestic water pumps shall be low lead/lead free bronze or brass unless otherwise specified.

c) The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring; suitable for continuous operation at 225 deg F. A bronze shaft sleeve shall completely cover the wetted area under the seal.

d) Pumps shall be rated for minimum of 175 psi working pressure. The pump case shall have gauge tappings at the suction and discharge nozzles and will include vent and drain ports.

e) Motor shall meet NEMA specifications and shall be the size, voltage, and enclosure called for on the plans. It shall have heavy-duty grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.

f) Each pump shall be factory tested per Hydraulic Institute Standards. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

g) Pumps shall be manufactured by ITT Bell & Gossett, Armstrong, Peerless, Aurora or Taco.

22-56 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. He 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 M/C 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.

22-57 ACCESS PANELS:

a) 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-inch by 6-inch.

b) Wall and Ceiling Access Doors: Doors shall be equivalent to Milcor DW, concealed frame, access panels. Frame shall be 16-gauge steel with a 14-gauge door panel prime coated with electrostatic powder. Lock shall be a screwdriver operated unless a keyed lock is noted on plans. Equals by Acudor, Babcock-Davis, Cesco, Elmdor, Karp, MiFab and Nystrom.

c) Fire Rated Wall/Ceiling Access Door: Doors shall be equivalent to Milcor UFR. 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. Equals by Acudor, Babcock-Davis, Cesco, Elmdor, Karp, MiFab and Nystrom.

22-58 SANITARY SEWER SERVICE:

a) Contractor shall connect to sanitary sewer connections provided per civil engineering plans.

b) Coordinate with the general contractor that all fees, charges, and costs incurred by the utility are included in the base bid.

22-59 DOMESTIC WATER SERVICE:

a) Contractor shall connect to water connections provided per civil engineering plans.

b) Coordinate with the general contractor that all fees, charge, and costs incurred by the utility are included in the base bid.

22-60 MASTER MIXING VALVE:

a) Provide a Leonard 8N-LF, Megatron mixing valve with all-bronze, recirculation pump capable of 1 to 190 gallons per minute with a maximum pressure drop of 10 psi.

b) Valve shall be rough brass and shall have 3" inlet and 3" outlet manifolds.

c) Mixing valve shall be capable of flowing from 1 gpm to 100 gpm without the use of pressure-reducing valves.

d) Provide thermometer on discharge header.

e) Each mixing valve shall have individual shut-offs for isolation.

f) Equivalents by Acorn, Lawler, Bradley, Powers, Symmons and Leonard.

22-61 WATER SOFTENER:

a) Basis of design is Kinetico CP213S OD water softener to remove mineral hardness from the water supply to a level not to exceed 17.1 mg/l as determined by an accepted ASTM or EDTA test method when the system is operated at 25 gpm and in accordance with operating instructions.

b) Water softener tanks shall be constructed of polyester reinforced fiberglass and be supported on a molded structural base. System shall include vacuum breakers, filters, and pressure gauges and all required components for complete and operational system to meet needs of the building for the hot water system only.

c) System shall have the capacity to operate at a variable water flow rate from a minimum of 20 gpm to a maximum of 40 gpm. Operating valve shall be motor driven mechanically activated with multiple positions to allow regeneration.

d) Main operating valve shall be a top mount design constructed of all brass and fitted with a fixed orifice eductor. Valve shall be motor driven mechanically activated design with self adjusting regulators to control the rate of flow and prevent resin loss during backwash regardless of system pressure fluctuations between 25 and 125 psi.

e) Integrated programmable electronic controller shall be provided to automatically cycle the system through the regeneration sequence. The electronic controller shall be manufactured by the same manufacturer as the water treatment equipment and shall come with a sealed keypad and audible alarm. Alarm shall be capable of being disabled by owner.

f) Ion exchange resin shall be high capacity "standard mesh" of sulfonated polystyrene type stable over the entire pH range with good resistance to bead fracture from attrition or osmotic shock. Resin shall be solid with particle size of 20-50 mesh and contain no agglomerates, shells, plates or other shapes that might interfere with the normal function of the water softener. Resin shall be manufactured to comply with the food additive regulation 21 CFR 173.25 as set forth by the USFDA.

g) Brine tank shall be included as part of softening system. Tank shall be provided with float operated shutoff valve separate from the main operating valve control to prevent overflow.

h) Manufacturer other than specified shall be submitted for owner approval.

END OF DIVISION 22

DIVISION 23 –HVAC

23-1 CONTRACT DOCUMENTS:

1. All contract documents including drawings, alternates, addenda, and modifications preceding this Specification Division are applicable to Mechanical Contractor and his subcontractors and material suppliers.

23-2 SPECIFICATION FORM AND DEFINITIONS:

1. 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.

2. When a word such as “proper,” “satisfactory,” “equivalent,” and “as directed” is used, it requires Engineer’s review.

3. “Provide” means furnish and install.

4. “Working Day” wherever used in these Specifications, shall mean the normal working days Monday through Friday, exclusive of Saturday, Sunday, and federally observed holidays.

5. Architect/Engineer hereinafter abbreviated A/E shall mean both the Design Architects and the Design Engineers.

6. Design Engineer hereinafter abbreviated D/E shall mean the engineering firm, RTM Engineering Consultants, 3333 E. Battlefield Suite 1000, Springfield, MO 65804, Telephone (417) 881-0020. Contact Person: Tyler Enserro.

7. General Contractor hereinafter abbreviated G/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the general division work.

8. Electrical Contractor hereinafter abbreviated E/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the electrical division work.

9. Mechanical Contractor hereinafter abbreviated M/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the mechanical division work.

10. Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred to.

23-3 GENERAL EXTENT OF WORK:

1. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory for proper operation and completion of mechanical systems. In no case will claims for “Extra Work” be allowed for work about which M/C could have informed himself before bids were taken.

2. M/C shall familiarize himself with equipment provided by other contractors, which require mechanical connections and controls.

23-4 LOCAL CONDITIONS:

1. Visit site and determine existing local conditions affecting work in contract.

2. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

23-5 CODES, ORDINANCES, RULES, AND REGULATIONS:

1. Provide work in accordance with applicable codes, rules, ordinances, and regulations of Local, State, and Federal Governments and other Authorities Having lawful Jurisdiction (AHJ).

2. Conform to latest editions and supplements of the following codes, standards, or recommended practices as adopted by the AHJ.

1. CITY CODES:

   A. 2012 International Plumbing Code.

   B. 2012 International Mechanical Code.

   C. 2012 International Building Code.

   D. 2012 International Fire 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 Standards Institute ANSI A117.1.

3. NATIONAL FIRE CODES:

   A. NFPA 54 Gas Appliance and Gas Piping Code.

   B. NFPA 70 National Electric Code – 2017 Edition.

   C. NFPA 89M Clearances, Heat Producing Appliances.

   D. NFPA 90A Air Conditioning and Ventilation Systems.

   E. NFPA 91 Blower and Exhaust Systems.

   F. NFPA 101 Life Safety Code – 2012 Edition.

3. 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.

4. 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,

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 A/E for approval.

5. M/C 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 (2) copies to A/E with request for final inspection.

23-6 CONTRACT CHANGE:

1. Changes or deviations from contract; including those for extra or additional work must be submitted in writing for review of A/E. No verbal orders will be recognized.

2. Changes in the work shall be submitted in accordance with AIA Document A201, General Conditions of the Contract for Construction.

3. 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 adjustment factors. If proposals are not itemized, they will be rejected and returned for proper submittal.

4. The maximum allowable profit for any change order shall be ten percent (10%).

5. See Example below:

PRICING SHEET

Project: Boiler Room Repairs for ABC Company Date: January 1, 2019
Location: Springfield, Missouri Estimator: Jane Doe
Labor Rate: $22.00

Material	Units	Unit Measure	Material Per Unit	Man Hours Per Unit	Total Man Hours	Material Total
6” tee	1	ea.	$45.00	2.000	2.0	$45.00
Less 6” ell	1	ea.	$30.00	0.000	0.0	$ 30.00
6” sch 40 pipe	23	ft.	$10.43	0.253	3.8	$ 56.46
6” cap	1	ea.	$11.00	1.500	1.5	$ 11.00
6” hanger	1	ea.	$12.00	0.400	0.4	$ 12.00
4” saddle weld	1	ea.	$0.00	1.200	1.2	$ 0.00
4” sch 40	18	ft.	$4.44	0.183	3.3	$ 79.92
4” ell	3	ea.	$13.39	2.000	6.0	$ 40.17
4” hanger	3	ea.	$8.00	0.300	0.9	$ 24.00
4” weld	1	ea.	$3.00	1.000	1.0	$ 3.00
1.5” cond sch 80	21	ft.	$1.63	0.080	1.7	$ 34.23
1.5” ell	3	ea.	$4.00	0.400	1.2	$ 12.00
1.5” tee	1	ea.	$5.00	0.600	0.6	$ 5.00
1.5” weld	1	ea.	$3.00	0.400	0.4	$ 3.00
0.75” F & T trap	1	ea.	$73.00	0.500	0.5	$ 73.00
0.75” strainer	1	ea.	$12.00	0.500	0.5	$ 12.00
0.75” XH nipples	4	ea.	$7.70	0.100	0.4	$ 30.80
0.75” unions	2	ea.	$3.18	0.300	0.6	$ 6.36
0.75” cap	1	ea.	$0.65	0.100	0.1	$ 0.65
0.75” pipe sch 80	10	ft.	$0.72	0.400	0.4	$ 7.20
0.75” tee	1	ea.	$1.50	0.300	0.3	$ 1.50
0.75” ell	3	ea.	$0.95	0.200	0.6	$ 2.85
0.75” hanger	2	ea.	$2.50	0.200	0.4	$ 5.00

SUBTOTAL					28.74	$618.47
SALES TAX				6.125%		$37.88
LABOR	28.4	MH	$22.00			$624.80
5% OVERHEAD						$64.06
8% PROFIT						$107.62
TOTAL						$1,452.83

23-7 LOCATIONS AND INTERFERENCES:

1. Locations of equipment, piping, and other mechanical work are 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 A/E.

2. 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 A/E prior to installation.

3. 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 the Contractor, his subcontractor, or his workmen shall be restored as specified for new work.

4. Do not scale mechanical and electrical drawings for dimensions. Accurately lay out work from dimensions indicated on architectural drawings unless such is found in error.

23-8 SYSTEM PERFORMANCE:

1. 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 and all required programming installed under this Specification.

2. Contractor shall be responsible for all work as required by phasing of construction for intended use by the owner as applicable.

23-9 WARRANTY:

1. M/C 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 (1) year from and after date of substantial completion of building and acceptance of mechanical systems by Owner.

2. Where manufacturers' warranties expire during the one (1) year warranty period, one (1) year warranty period is defined as year after date of substantial completion. M/C shall include provisions for extending warranty for the full one (1) year period and shall cost for warranty extension in his base bid.

3. M/C warrants to Owner and Architect that on receipt of written notice from either of them within one (1) 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 M/C's expense.

4. The above warranty shall not supersede any separately stated warranty or other requirements by law or by these Specifications.

5. If the Architect's specification includes a warranty that exceeds the above warranty requirements, the Architect's warranty shall take precedence.

23-10 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS:

1. The intent of these Specifications is to allow ample opportunity for M/C 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.

2. Material and equipment installed under this contract shall be first class quality, new, unused, and without damage.

3. 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 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 M/C'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 D/E.

4. 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 A/E for review prior to procurement.

5. **PRIOR TO RECEIPT OF BIDS, IF M/C WISHES TO INCORPORATE PRODUCTS OTHER THAN THOSE NAMED IN SPECIFICATIONS IN HIS BASE BID, HE SHALL SUBMIT A WRITTEN REQUEST FOR REVIEW OF SUBSTITUTIONS TO D/E NOT LESS THAN SEVEN (7) WORKING DAYS PRIOR TO BID TIME. D/E WILL REVIEW REQUESTS AND ACCEPTABLE ITEMS WILL BE LISTED IN AN ADDENDUM ISSUED TO PRINCIPAL BIDDERS.**

6. 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 A/E, 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 (2) copies of complete descriptive and technical data including E/M's name, model, and catalog number, photographs or cuts, physical dimensions, operating characteristics, and any other information needed for comparison.

7. 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 are under this contract or under separate contracts.

8. Within seven (7) working days after bids are received, apparent lower bidder shall submit to A/E for approval three (3) 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, M/C shall submit shop drawings for equipment and materials to be incorporated in work, for A/E review. Where 30 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, M/C 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.

9. After execution of contract, substitution of product brands for those named in Specifications will be considered, only if; 1) request is received within 30 days after contract date and request includes statement showing credit due Owner, if any, if substitution products are used, or 2) Owner requests consideration be given to substitute brands.

23-11 SHOP DRAWINGS, OPERATION, AND MAINTENANCE INSTRUCTION:

1. Unless noted differently in the general requirements of the specifications, M/C shall furnish a minimum of six (6) sets of shop drawings of all materials and equipment, Engineer will retain one (1) set.

2. 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, or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear E/M's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

3. M/C shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the A/E for their review. All shop drawings submitted to A/E shall bear M/C approval stamp which shall indicate that M/C has reviewed submittals and that they meet Specification and/or drawing requirements. M/C's submittal review shall specifically check for, but not 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 M/C's approval shall be returned to his supplier for resubmittal.

4. No shop drawing submittals will be considered for review by the A/E without M/C's approval stamp, or that have extensive changes made on the original submittal as a result of Contractor's review. All comments or minor notations on shop drawings shall be flagged as follows to indicate originator of comment or notation: 1 Contractor, 2 Construction Manager, 3 Architect, and 4 Engineer.

5. A/E will not be responsible for the cost of returning shop drawing submittals that are submitted to them without M/C's review and approval stamp. A letter will be sent to M/C by either the Architect or Engineer indicating receipt of an improper submittal. M//C shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. A/E will hold improper submittals for pick-up by M/C or supplier for 23 working days after date of receipt. If not picked up by the 26th working day, submittals will be disposed of by A/E.

6. A/E's review of shop drawings will not relieve M/C of responsibility for deviations from drawings and specifications unless such deviations have been specifically approved in writing to Owner or his representative, nor shall it relieve M/C of responsibility for errors in shop drawings. No work shall be fabricated until A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be M/C's responsibility.

1. Operating and Maintenance Instructions:

1. Submit with shop drawings of equipment: copies of installation, operating, maintenance instructions, and parts list for equipment provided. Instructions shall be prepared by E/M.

2. Keep in safe place keys and wrenches furnished with equipment under this contract. Present to Owner and obtain a receipt for same upon completion of project.

3. Contractor shall provide all final documents including drawings, shop drawings, etc. in PDF format on a single disk to Owner. A total of five (5) CD's shall be provided, three (3) to the Owner and two (2) to A/E. No exceptions will be allowed to this requirement. Videotaping, as specified in other parts of this Specification, will also be required at closeout.

23-12 PROPOSED VALUE ENGINEERING/PROJECT SCOPE REVISIONS:

a) Where design revisions are requested/required based on value-engineering or proposed changes in project scope, the contractor shall include in his proposed cost savings or adds the necessary MEP design fees that are required for modifying construction documents and associated meetings. In order to determine that value to be included, the contractor shall submit to the A/E the proposed scope of the work required for the changes at least 7 days prior to required pricing submittal so that the design fees can be accurately determined and included. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

b) Where the contractor proposes to use different equipment that results in significant difference in routing or space considerations than shown in the construction documents, the contractor shall include the necessary MEP design fees that are required for modifying or creating construction drawings necessary either for construction or submission to the authority having jurisdiction and required for additional review. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

23-13 CAD/BIM FILE REQUESTS:

1. CAD files and/or BIM models (only where created as part of the project design) are the property of the D/E and are only available upon documented written request. Prior to receiving any CAD files or models, the contractor shall submit a drawing cost fee of $50/drawing up to a maximum $1500 (BIM MEP models are $500). In addition, the contractor must sign a Third Party User Agreement and Drawing Request Form which must be forwarded to the D/E office prior to any CAD files being released. This form is available from the D/E upon request.

23-14 CUTTING AND PATCHING:

1. M/C 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.

2. Patching shall be by mechanics of particular trade involved and shall meet approval of Architect.

3. 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.

23-15 MUTILATION:

1. Mutilation of building finishes, caused by installation of mechanical equipment, fixtures, piping, and other mechanical devices shall be repaired at M/C's expense to approval of Architect.

23-16 EXCAVATION AND BACKFILL:

1. 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.

2. Excavate trenches of sufficient width to allow ample working space, and a minimum of 6", and no deeper than necessary, for installation work.

3. 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 A/E. Mechanically tamp backfill under concrete and paving in 6-inch layers to 95 percent standard density.

4. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moisten as required for specified compaction density. Dispose of excess earth, rubble, and debris as directed by Architect.

5. When available, refer to test-hole information on Architectural drawings or specifications for types of soil to be encountered in excavation in base bid.

6. Trenches shall be installed to have a bedding of natural or artificial graded fixture of crushed gravel or sand with 100% passing a 1 inch sieve and not more than 8% passing a #200 sieve. All depressions shall be filled with tamped and sand backfill. Place and compact backfill of sub-base material free of particles larger than 1" over piping. Compact each 6" layer at 85% density. Install warning tape directly above piping outside the building at 12" below grade.

7. Gravel for use of backfill will not be accepted unless approved by Engineer.

8. Notify Engineer two (2) business days prior to plumbing inspection by AHJ so that Engineer can visually inspect piping prior to backfill.

23-17 SETTING, ADJUSTMENT, AND EQUIPMENT SUPPORTS:

1. Work shall include mounting, alignment, and adjustment of systems and equipment.

2. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown, specified, or required by E/M's installation instructions.

3. Provide concrete bases for all floor and slab mounted equipment. Refer to drawings for required base type and size. Provide 3.5-inch high base where base is not shown on drawings.

23-18 START-UP, CHANGE-OVER, TRAINING, AND OPERATIONAL CHECKS:

1. M/C 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 E/M's technicians, when specified, and Owner's operating personnel shall be present during these operations.

23-19 PRE-FINAL AND FINAL CONSTRUCTION REVIEW:

1. At M/C's request, A/E 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 A/E as not complete or not in accordance with requirements of contract will be outlined in report to M/C. After completion and/or correction of these items M/C shall notify Architect he is ready for final review.

2. 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 A/E at least ten (10) working days prior to date of final construction review.

3. At final construction review, M/C and his major subcontractors shall be present or shall be represented by a person of authority. Each contractor shall demonstrate, as directed by A/E, that his 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.

23-20 PAINTING OF MATERIALS AND EQUIPMENT:

1. Equipment and materials exposed to interior dry environment shall have a minimum of one (1) primer and one (1) finish coat. Equipment and materials mounted in exterior location shall have a minimum of one (1) primer and two (2) finish coats with total thickness of at least 5 mils. Finish coat colors in finish areas shall be as selected by A/E.

2. 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.

3. Where extensive refinishing of factory applied finishes are required, equipment shall be completely repainted. A/E will make final determination of extent of refinishing required.

23-21 MAINTENANCE OF SYSTEMS:

1. M/C shall be responsible for operation, maintenance, and lubrication of equipment installed under his contract.

23-22 FILTERS:

1. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems 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 A/E.

2. Unless shown or specified otherwise 2” AP-Thirteen, MERV 13 minimum filter efficiency in all rooftop and air handling units. All units 2,000 cfm and greater shall be provided with MERV 8 pre-filters and MERV-13 final filters.

3. All filter frames for air handling, dedicated outdoor air, make-up air and energy recovery units shall be synthetic. Cardboard frames are not acceptable. All filters shall be accessible through hinged access door with clamp – screw or other mechanical removal is not acceptable.

4. Unless shown or specified otherwise, provide Farr filters. MERV 8 minimum filter efficiency in all fan coil units, VRF units and fan terminal units.

23-23 CLEANING OF HVAC SYSTEM AND EQUIPMENT:

1. After pressure testing of systems and equipment and before operational test, thoroughly clean interiors of ductwork and equipment.

2. Clean equipment as recommended by manufacturers. Where specific instructions are not provided by equipment manufacturer, clean equipment systems as follows:

1. 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 eight (8) hours at full volume. Replace temporary filters with final filters immediately prior to testing and balancing.

23-24 PIPING IDENTIFICATION:

1. Identify piping in mechanical rooms, above ceilings, 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.

2. Place piping markers so they can be easily read from operating position and floor.

3. Mark piping with marker and a 3-inch-wide bank of identification color around circumference of pipe in lieu of painting complete pipe or pipe covering.

4. 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.

5. See Schedule.

PIPING IDENTIFICATION SCHEDULE

Service	Letter Wording	Marker Color	Letter Color
A/C Condensate Drain	Drain	Green	White
Refrigerated Liquid	Refrigerated Liquid	Yellow	Black
Refrigerated Suction	Refrigerated Suction	Yellow	Black

23-25 VALVE IDENTIFICATION:

1. Mark all valves with Seaton No. 300-BL brass identification tags with system legend, valve number, and size stamped on tag. Lettering shall be black 0.5-inch high. Tags shall be 2-inch-diameter and attached to valve with Seaton No. 26 brass jack chain. Equals by Craftmark, Koby or MSI.

2. Prepare four (4) copies of a type written list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function, and location. Frame one list under glass and mount near operating instructions in main equipment room.

3. Provide tag on ceiling tile where valves are located above ceiling tiles.

23-26 PIPE SLEEVES:

1. 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. Sleeves shall not be provided in rated floors requiring fire seals.

2. 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.

3. Sleeves passing through floors with waterproof membranes shall be core-drilled and sealed with Thunderline Link-Seal or Calpico Sealing Linx.

4. Sleeves passing through walls with waterproof membranes shall be sealed with Thunderline Link-Seal or Calpico Sealing Linx.

5. Pipe insulation shall run continuous through pipe sleeves with 0.25-inch minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through 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 0.375-inch-wide band. Provide Kaowool fire master bulk packing between sleeve and metal jacket. 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.

6. 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.

23-27 EXPANSION JOINTS, LOOPS, ANCHORS, AND GUIDES:

1. Provide for proper control of expansion and contraction of piping systems by means of expansion loops, expansion joints, or ball joints. Piping from mains to equipment, branches, and risers shall be provided with swing, swivel joints, or off sets to relieve stresses due to expansion or contraction of piping.

2. Provide pipe loops as shown on drawings or specified. Where pipe loop dimensions are not shown on plans, they shall be as recommended by pipe manufacturer based on thermal expansion.

3. Provide telescoping, expansion joints on all vertical CPVC piping. Joint shall be provided with triple EPDM or FKM, O-ring seals in internal support piston. All expansion joints shall be pressure rated to match the CPVC piping from material conforming to ASTM D 1784 with dimensional requirements per ASTM D 2467 and installed per manufacturer's requirements based upon length and temperature change.

4. Anchor and guide piping where indicated or required to control extension and direction of pipe expansion. Install pipe alignment guides as recommended by expansion joint manufacturer. Where anchors are not detailed on drawings, provide anchors capable of withstanding calculated anchor forces. Attach anchor supports to building structure where weight or expansion of pipe line will not damage structure.

23-28 WELDING:

1. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society AWS B3.0 and ANSI Z49.1.

2. Welding shall be done only be 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 (3) copies of a list of welders who will work on project listing welder's code, date, and types of latest qualification tests passed by each welder.

3. Welded joints shall be fusion welded in accordance with Level AR3 of 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.

4. 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.

23-29 PIPING MATERIALS AND FITTINGS:

1. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturer's name and weight. All materials listed may not be required on this project. See piping material schedules, on drawings, for materials to be used for each piping system. Piping materials shall be as follows:

1. Carbon Steel Pipe:

   A. Provide continuous weld or electric resistance welded carbon steel pipe conforming to ASTM A120 or A53, as scheduled.

   B. Pipe joints shall be threaded conforming to ANSI B2.1, beveled for welding, or grooved for use with Victaulic couplings.

   C. Pipe by Armco, Youngstown, United States Steel, or equal.

2. Polyvinyl Chloride (PVC) Pipe:

   A. Provide Type 1, Grade 1 PVC pipe conforming to requirements of current ASTM D 1785 for pressure piping as scheduled. Pipe shall be approved by NSF for potable water.

   B. Piping for pressure piping shall have plain ends for socket type fittings.

   C. Pipe by Chemtrol, Charlotte, Tyler, Pipelife, Cabot, or equal.

3. Copper Tube:

   A. Provide hard temper copper water tube conforming to requirements of current ASTM 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.

4. Chlorinated Polyvinyl Chloride (CPVC) Pipe:

   A. 2" and smaller to be Copper Tube Size (CTS) CPVC pipe and fittings – Conforming to ASTM D2846, FlowGuard Gold CPVC compound material and shall meet a cell class rating of 24448 as defined by ASTM D1784, and shall be certified/labeled by NSF International for use in potable water systems.

      i. FlowGuard Gold material shall meet the flame spread / smoke developed rating of 25/50 as tested in accordance with ASTM E 84, and shall be tested empty and have third party test data available confirming material meets the 25/50 requirement.

   B. Pipe by Charlotte, Cresline, Genova, GF Harvel, Bow, IPEX and Nibco

5. Copper Tube Type ACR:

   A. Provide hard or annealed temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B 280. Tubing 2" and larger shall be hard temper.

   B. Tubing joints shall be brazed or grooved joints shall be manufactured to copper-tube dimensions. (Flaring tube endings to accommodate alternate sized couplings is not allowed.)

C. Pipe by Cerro, Mueller, or equal.

23-30 PIPE FITTINGS:

1. Pipe 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 B26.9 and ASTM A234.

   B. Fittings by Grinnell, Midwest, or equal.

2. Branch Connection Welding Fittings:

   A. Provide carbon steel weldolet fittings conforming to ANSI B26.9, B26.11, B31.1.0, and ASTM A105, Grade 11.

   B. Fittings by Bonney Forge or equal.

3. Branch Connection Welding to Screwed Fitting:

   A. Provide carbon steel threadolet fitting conforming to ANSI B26.9, B26.1.1, B31.1, and ASTM A105, Grade 11.

   B. Fittings by Bonney Forge or equal.

4. Carbon Steel Flanges:

   A. Provide carbon steel flanges conforming to ASTM A 181, Grade 1 and ANSI B26.5

   B. Flanges by Grinnell, Midwest, or equal.

   F. Couplings by Victaulic Company, Shurjoint, or “Gruvagrip” by Gustin-Bacon.

5. Wrought Copper Fittings:

   A. Provide wrought solder joint copper tube fitting conforming to ANSI B16.22.

   B. Fittings by Chase, Nibco, or equal.

6. PVC, Schedule 40 Pressure Fittings:

   A. Provide NSF rated, Schedule 40, PVC socket fittings conforming to ASTM D 2466.

   B. Solvent cement of socket fittings shall conform to ASTM D 2564.

   C. Fittings by Tyler, Charlotte, or equal.

7. Pipe Flange Gaskets:

   A. Gaskets by Durable Manufacturing Co., Garlock Co., or equal.

23-31 INSULATING UNIONS AND FLANGES:

1. 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. Steel pipe to steel pipe screwed end:

   A. Provide Stockham malleable iron No. 693-0.5 insulating union with high dielectric strength insulating sleeve and gasket.

2. Steel pipe to steel pipe flanged end:

   A. Provide two (2) weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.

3. 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 deg F. Equal by Capitol Manufacturing, Central Plastics and Watts Regulator.

   B. Dielectric nipples shall not be used.

23-32 UNIONS:

1. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.

2. Provide Stockham brass seat unions of material and pressure rating required by piping system.

3. Where piping systems of dissimilar materials are jointed together, provide proper insulating union as specified under this Specification.

23-33 PIPING INSTALLATION:

1. Piping systems materials and installation shall conform to the following standards and codes:

1. System: Heating and Air Conditioning Piping Code: ANSI Standard B31.9 "Power Piping"

2. 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 half-inch. In no case shall piping smaller than size specified be used.

3. 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 manufacturer's 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 manufacturer's recommendations for fixed hanger and supports. Provide copper plated hangers and supports for suspension of un-insulated copper tubing lines.

4. Provide escutcheon plates on all piping penetrations of exposed walls. Paint to match exposed surface.

5. Install all piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping systems. 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.

6. Install piping so that systems can be completely drained. Provide piping systems with valved drain connections at all low points and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be as follows:

PIPE SIZE	DRAIN SIZE
0.75” THROUGH 2”	0.75”
2.5” thru 5”	1”
6” thru 18”	1.25”
20” thru 36”	1.5”

Drain valves on closed piping systems such as chilled water systems shall be with plugged or capped outlets to protect systems from inadvertent drainage.

7. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drops in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.

8. Provide piping materials and wall thickness for specific piping systems as listed in piping schedules in Section 23. Steel piping systems 2.5 inches and under shall be threaded pipe fittings. Steel pipe systems 3 inches and above shall be welded end pipe and fittings unless required otherwise by Code.

9. Where listed in piping schedules or noted on drawings, provide 2 inches and larger with Victaulic grooved couplings as specified.

10. 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.

11. 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 mitered or field fabricated pipe fittings will be permitted.

12. All pipe threads shall meet ANSI 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.

13. 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.

14. 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.

15. Soft soldered socket type joints shall be made with 95-5 tin-antimony solder as required by temperature and pressure rating of piping systems. Solder 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.

16. Make changes in piping size and direction with approved factory made fittings. Steel pipe and fittings suitable for at least 125 psi working pressure or of pressure rating required for maximum working pressure of system, whichever is greater.

23-34 VALVES AND INSTALLATION:

1. 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.

2. Valves 2.5 inches and smaller 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 2 feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3 inches and over shall have flange end connections or butt weld ends as scheduled. Optional Victaulic grooved valves may be used where scheduled.

3. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance.

4. 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.

5. Valves shall be the same size as piping shown on drawings. Do not reduce valve size.

23-35 PIPE HANGERS AND SUPPORTS:

1. 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 MSS SP-58.

2. 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 inducted into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.

3. Factory made hangers, attachments and supports to be by Tolco, ZSI, or Anvil and must be installed per manufacturer’s requirements. All other hangers, attachments and supports must be approved by A/E prior to installation.

4. Hangers, strut, clamps and supports located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. If located in a corrosive area, hangers, strut, and clamps shall be type 304 (326) stainless steel with stainless steel hardware.

5. Clamps on all hydronic piping shall be fully insulated equal to an Anvil Cush-A-Therm. Cushioned or bare clamps that are not fully insulated are not allowed. Insulation material and thickness shall match specified material.

6. 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 support pipe.

7. 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.

8. Hangers in direct contact with copper pipe or tubing shall be copper or plated coated with copper-colored epoxy paint.

9. Unless indicated otherwise on drawings, support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
0.5” to 0.75”	0.375”	6’
1” to 1.25”	0.375”	8’
1.5”	0.375”	9’
2”	0.375”	10’
2.5” to 3”	0.5”	12’
4” to 5”	0.625”	14’
6”	0.75”	17’
8”	0.875”	19’
10” to 12”	0.875”	21’

10. Unless indicated otherwise on drawings, support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1”	0.375”	6’
1.25” And 1.5”	0.375”	6’
2”	0.375”	9’
2.5”	0.5”	9’
3” and 4”	0.5”	10’

11. Support plastic piping as recommended by piping manufacturer.

12. 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.

13. Provide continuous thread 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 A/E for review prior to fabrication.

14. Provide Tolco or Anvil pipe hangers for vertical pipe risers per MSS Type 8 or 42:

    Type 8: Tolco Fig. 6 or Anvil Fig. 261.

    Type 42: Tolco Fig. 14 or Anvil Fig 295.

15. Provide Tolco Fig. 30 steel wall brackets for piping suspended or supported from walls. Brackets shall be carbon steel and selected to meet the load. Finish to be hot dip galvanized in outdoor applications and type 304 (326) stainless steel in corrosive areas.

16. Where hangers are placed outside the jackets of pipe insulation, provide galvanized metal shields. Minimum 12” Long per MSS-SP-58.

17. Mount hangers for insulated piping on outside of pipe, hangers sized to allow for full thickness of pipe insulation. Shield shall support lower 180 degrees of pipe insulation. Omit copper plating on hangers mounted outside insulation on copper tubing.

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2" to 1-1/2"	12”	18
2" to 6"	12”	18
8" to 10"	18”	26
12" to 18"	24”	14
20" & Larger	24”	12

18. Where roller hangers are required and heat loss must be kept to minimum, use Tolco Fig. 260 – Fig. 265 as required by insulation thickness and pipe size.

19. Structural attachments for pipe hangers shall be as follows:

1. For upper attachment for suspending pipe hangers from concrete: Concrete inserts MSS Type 18. Tolco Fig. 309 or Anvil Fig. 282

2. For attachment to top flange of structural shape: Top beam C-clamps, MSS Type 19. Tolco Fig. 68 or Anvil Fig. 94

3. For attachment to bottom flange of structural shape: Side beam or channel clamps, MSS Type 27. Tolco Fig. 336 or Anvil Fig. 14.

4. For attachment to center of bottom flange of beams: Center beam clamps, MSS Type 21. Tolco Fig. 62 or Anvil Fig. 133.

5. For attachment to bottom of beams where heavy loads are encountered and hanger rod sizes are large: Welded attachments, MSS Type 22. Tolco Fig. 305 or Anvil Fig. 66.

6. For attachment to structural shapes: C-clamps, MSS Type 23. Tolco Fig. 64 or Anvil Fig. 95.

7. For attachment to top of beams when hanger rod is required tangent to edge of flange: Top I-beam clamps, MSS Type 25. Tolco Fig. 335 or Anvil Fig. 217.

8. For attachment to bottom of steel I-beams for heavy loads: Steel I-beam/WF-beam clamps with eye nut for pipe size 12”and smaller MSS Type 28. Tolco Fig. 62 or Anvil Fig. 133. For pipe size 14” and larger MSS Type 29 Tolco Fig. 297SP or Anvil Fig. 292L

9. Provide Tolco Fig. 506 vibration control hangers at locations on piping to prevent vibrations from being transmitted to building structure by conventional hangers. Apply hangers within their load supporting range and per the following:

    A. All pipe supports on lines that are connected directly to rotating equipment that have no flexible connection between equipment and piping.

    B. All pipe supports within the first 50 lineal feet after a flexible connection to rotating equipment. All supports between the flexible connection and the rotating equipment.

    C. All pipe supports that are attached to piping that is not connected to rotating equipment is exempt from vibration isolation.

20. Provide Anvil International, Inc. 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	0.375” though 4”	PS1100	PS1901
Steel	0.375” through 6”	PS1100	PS1902

21. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Anvil International, Inc. Fig. 259 or equivalent by Advanced Thermal Systems. Where racks and supports are not detailed on drawings, submit detailed support drawings to A/E for review prior to fabrication.

22. Provide Control Devices HGR Series vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.

23. Provide TOLCO fig 318A and 326T combination pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.

24. All piping installed on roofs (except metal roofs) shall be supported by MIRO Industries “Pillow Block Pipe stands.” The base of the stand shall be designed to prevent gouging and ripping the roof membrane. The pipe stands shall be designed to absorb shock and thermal expansion and contraction reducing the friction from pipe movement.

25. Provide Tolco Fig. 20 or Anvil Fig. 262 short strap for attaching pipe tight to ceilings as noted on plans.

26. 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.

27. Equivalent hangers and supports by Tolco, Anvil, PHD, Anvil International, Inc., or Fluorcarbon Company.

23-36 EQUIPMENT ANCHORS:

1. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Hilti concrete anchors.

2. Where equipment anchors cannot be installed during forming of floors or foundations, anchor equipment with Hilti HCI-MD concrete anchors.

3. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

4. Equals by ITW, Masterset, MKT Fastening, and Power Fastening.

23-37 CONCRETE INSERTS AND ANCHORS:

1. Provide concrete inserts for attaching piping and equipment as follows:

1. In new construction where attachment points can be predetermined, provide PHD Fig. 950 continuous concrete insert of Fig. 950N Universal Steel Concrete insert.

2. In existing construction or new construction where attachment points cannot be located before setting concrete forms, provide McCullock Kwik-Bolt or Phillips red head concrete anchors of proper type for attachments.

2. Equals by ITW, Masterset, MKT Fastening, and Power Fastening.

23-38 TESTING PROCEDURES:

1. 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.

2. Where entire system cannot be tested before concealment, test system in sections. Upon completion, each system shall be tested as entire system.

3. Repair or replace defects, leaks, and materials failures revealed by tests and then retested until satisfactory. Make repairs with new materials.

4. 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.

5. Test methods are pressures shall be as follows:

1. Hydrostatic Test (Closed System):

   A. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for systems or 230 percent of operating pressure where not specified.

2. Hydrostatic Test (Open System):

   A. Test entire system with 10 feet of head 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 head water. Water shall be held in system for 23 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 230 percent of operating pressure, 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. Refrigerant Piping:

   A. Test piping by pneumatic test using carbon dioxide or dry nitrogen. Test high and low side of refrigerant system for minimum leakage as specified in ANSI B9.1 for refrigerant used.

   B. System shall successfully hold test pressure for 24 hours without pressure drop. Following pressure test, evacuate entire system to an absolute pressure of 5,000 microns at ambient temperature of not less than 55 deg F. System shall hold vacuum for two (2) hours with absolute pressure increase of not more than 25 microns.

   C. Following successful completion of vacuum test, immediately charge system with refrigerant.

5. 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.

6. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.

7. Upon completion of testing submit five (5) copies of typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time, and all failures with corrective action taken.

8. For test pressures see piping material schedule.

23-39 PIPING AND EQUIPMENT INSULATION:

1. 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.

2. Provide insulation materials manufactured by Certain Teed, Knauf, Dow Chemical Company, Johns Manville, or Owen/Corning Fiberglas.

3. 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

4. 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. Treatments 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.

5. 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 degree 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 insulations sections.

6. 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.

7. Where glass is specified in the following insulation methods, provide resin impregnated with open weave glass fabric with 10/20 thread count.

8. Abbreviations for manufacturers of adhesives, mastics, and coating specified shall be C.M. for Chicago Mastic Company and B.F. for Benjamin Foster Company.

9. Provide piping systems scheduled for metal insulation jacket with insulation system type specified except omit factory applied jackets on plastic foam or calcium silicate insulation unless indicated otherwise in schedule. Secure insulation with 1.5-inch-wide pressure sensitive type bands on plastic foam insulation and with galvanized tie wire on calcium silicate insulation system with stucco embossed aluminum vapor barrier metal jacket and matching aluminum

fitting covers by Childers Products Co., Harren Metals Inc., or Premetco International. Lay fitting covers 2 inches over adjacent insulation jacket and apply 4-inch butt joint strips secured with stainless steel bands Jacket thickness shall be as scheduled with interior surfaces of metal fitting covers factory or field coated with not less than 10 mil thickness of C.M. No. 26-110 or B.F. No. 30-36 mastic coating. Jacket length shall be 3 or 4 feet applied with longitudinal and circumferential joints sealed with 0.125-inch bead of butyl or elastomeric sealant and lapped 2 inches over adjacent cover. Secure cover on piping 12 inches OD and smaller on 2-inch OD and above piping. Bands shall have thumb seals and be coated on 6-inch centers on piping 6-inches OD and smaller and on 12-inch centers on piping 8 inches and larger. Attach bands on aluminum jackets that cover insulation without vapor barrier jacket with one pop rivet, secure bands on aluminum jackets that cover insulation with vapor barrier jackets by cutting diagonal cut in longitudinal lap adjacent on piping within 6 feet of floor shall be 0.020-inch-thick or double jacket of 0.026-inch thickness.

10. Piping insulation materials and application methods by type shall be as follows:

1. TYPE 2-PC: Insulation for cold surface piping system with minus 50 deg F to plus 220 deg F operating temperature range shall be Armstrong AP Armaflex Elastomeric pipe insulation average thermal conductivity shall not exceed 0.27 BTU/Hr. at 75 deg 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 520 adhesive. Thickness shall be per manufacturer's recommendations using a maximum severity of 90 deg F and 80 percent RA. 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 520 adhesive. Finish insulation as soon as possible with two coats of Armstrong Armaflex water-based, latex enamel finish in color selected by Architect. All insulation used outdoors shall be painted to prevent ultra violet deterioration of insulation.

11. 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 ITW Trymer Supercel Phenolic inserts or equal of half or full sections of pre-molded pipe insulation equal in thickness to adjoining insulation. Provide inserts with vapor barrier jacket for lapping 2 inches over adjacent pipe insulation jacket. Protect insulation with insulation shields supporting lower 180 degree 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. Materials shall meet the ASTM E84 burn characteristics of 25/50.

2. Insulate pipe anchors in direct contact with cold piping for a distance of 12 inches or as detailed on drawings form 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 pre-molded pipe insulation equal in thickness to adjoining pipe insulation. Provide inserts with vapor barrier jacket for overlapping 2 inches 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 pre-molded 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 cannot be isolated from cold pipe surfaces, insulate piping at hanger locations with extra thickness of pipe insulation. Insulate hanger rod to a point 12 inches 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 0.5-inch-thick Armstrong FR/Armaflex pipe or sheet insulation as required by surface. Insulate supports from pipe to floor plate and seal insulation joints with Armstrong No. 520. Finish insulation with Armstrong Armaflex vinyl-lacquer finish.

7. All pipe insulation shall be continuous through walls, ceiling, or floor openings or sleeves except where firestop or firesafing materials are required.

12. Insulation of removable heads and valves, manhole 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.

13. 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 (1) year after date of final acceptance or through one (1) heating season and one (1) 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 M/C's expense at no cost to Owner.

23-40 DUCTWORK INSULATION:

1. 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 23 of this Specification.

2. Provide insulation materials manufactured by Owens-Corning, John Manville, CertainTeed, or Knauf.

3. 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

4. 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./deg F/in.

5. Install interior duct liner insulation cut to insure tight fitting corner and longitudinal joints. Apply liner to sheet metal with 100 percent coverage of C.M. No. 17-477, B.F. No. 81-18, or 3M manufacturer's recommended application rate. Coat all edges of liner with adhesive. Provide mechanical fasteners on surfaces 18 inches 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 inches of leading edge of each section 12 inches OC around joint perimeter and 3 inches from longitudinal joints at 12 inches OC. Elsewhere space fasteners 18 inches OC except not more than 6 inches from longitudinal joints nor 12 inches from corner break.

6. Provide concealed round ductwork with exterior thermal insulation of type and thickness listed in schedule. Apply insulation to duct with C.M. No 17-477 or B.F. No. 85-20 adhesive. Provide mechanical fasteners 18 inches OC on duct width 30 inches and greater. Butt insulation joints tightly together and lap facing 2 inches over adjacent insulation and seal with vapor barrier adhesive. Seal all breaks with vapor barrier adhesive and vapor barrier tape matching insulation facing.

7. Provide exposed rectangular ductwork with exterior thermal insulation of type and thickness listed in insulation schedule. Apply with mechanical fasteners spaced 12 inches OC with minimum of two (2) rows per duct side. Seal fasteners, joint breaks, and punctures with vapor barrier adhesive reinforced with 3-inch-wide vapor barrier tape matching insulation facing.

8. 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 to equal adjoining insulation with cover overlapping 2 inches onto adjacent covering.

9. 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 CertainTeed 2-pound density Toughgard R duct liner with 0.24 BTUH thermal conductivity at 75 deg F mean temperature. Facing shall have a maximum water vapor sorption rate of 3 percent by weight. Approved for use in return air plenums, conforms to ASTM E84 requirements and withstands temperatures of 250˚.

2. TYPE 4-DEW: External thermal insulation for rectangular or round duct shall be CertainTeed, type 100, 1.0-pound per cubic foot density standard duct insulation complying with ASTM C 1290 and ASTM C 553 and 0.26 BTUH thermal conductivity at 75 deg F mean temperature. Provide foilscrim-kraft facing, FSK, meeting the requirements of ASTM C1136 with a maximum vapor transmission rate of 0.02 perms.

3. TYPE 6-DEW: External thermal insulation for rectangular or round duct shall be Armacell, Armatuff Plus, 3-pound density, closed-cell elastomeric insulation with a white thermoplastic rubber membrane and 0.25 BTUH thermal conductivity at 75 deg F mean temperature with 0.2% water absorption. Insulation shall meet ASTM C 534 requirements and the joints shall be sealed with Armatuff 25 seal tape. Equals by prior approval only.

4. TYPE 7-DEB: External thermal insulation for rectangular duct Dow Styrofoam Square Edge, extruded polystyrene with a 5.0 BTUH thermal resistance per inch at 75 deg F mean temperature. Facing shall have a maximum vapor transmission rate of 1.1 perms. Insulation shall only be used on the exterior of the building.

23-41 ELECTRICAL REQUIREMENTS:

1. Consult Section 26 of electrical Specifications for work to be provided by E/C in conjunction with installation of mechanical equipment.

2. Electrical work required to install and control mechanical equipment which is not shown on plans or specified under Section 26 shall be included in M/C's base bid proposal.

3. 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 Section 23-A-10g of Specifications shall be paid by M/C at no cost to owner or A/E.

4. M/C shall be responsible for providing supervision to E/C to insure that required connections, interlocking, and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.

5. Furnish six (6) complete sets of electrical wiring diagrams to A/E and three (3) complete sets to E/C. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by E/C shall be clearly indicated by notation and drawing symbols on wiring diagrams.

6. M/C shall obtain complete electrical data on mechanical shop drawings and shall list this data on approval form which shall be presented monthly, or on request, to E/C. 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, and locked current to allow E/C to order electrical equipment required in his contract.

7. Safety disconnect switches and manual and magnetic motor starters shall be provided by E/C. Exceptions will be allowed where mechanical equipment is specified with these devices installed as part of factory built control systems.

23-42 CAPACITORS:

1. See Section 26 of the electrical section of these Specifications regarding capacitors.

2. Cost of additional capacitance beyond that specified shall be borne by the Contractor providing the motor.

23-43 RECORD DOCUMENTS:

1. 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 sheers into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on cover of each sheet.

2. 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:

1. Piping.

2. Conduits.

3. Ductwork.

3. The Contractor shall provide the photographs in an 8.5-inch by 11-inch format for record keeping purposes with the maintenance manuals. The photos shall all be digital and a disk or CD shall be provided to the Owner as a permanent record.

4. 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.

23-44 PIPING SYSTEMS MATERIALS:

1. Refer to Section 23 of this specification for piping material specifications and installation instructions.

2. See schedule for specific piping materials and joining methods for systems installed under this section.

23-45 PIPING SYSTEM INSULATION SCHEDULE:

1. Refer to Section 23 for insulation type specifications and installation instructions.

2. See schedule for insulation types and thickness for piping installed under this section.

PIPING INSULATION SCHEDULE

Service	Size	Type	Thickness
Refrigerant Lines (Interior)	All	2-PC	0.5”
Refrigerant Lines (Exterior)*	All	2-PC	0.5”
A/C Condensate Drain	Up to 2”	2-PC	0.5”
A/C Condensate Drain	2.5” & Up	2-PC	0.75”

*All exterior piping insulation shall be painted with ultraviolet-resistant paint. Color as selected by architect. Provide 0.024” thick, aluminum jacket on all exterior piping.

23-46 DUCTWORK INSULATION SCHEDULE:

1. Refer to Section 23 for ductwork insulation specifications and installation instructions.

2. See schedule for insulation for ductwork to be insulated under this section.

3. **Ductwork scheduled for internal lining is NOT sized on the drawings to include the lining. Size shown on the drawing is the inside duct measurement.**

DUCTWORK INSULATION SCHEDULE

System	Type	Thickness
Supply Air – Rectangular-Low Velocity	1-DIL	0.5”
Supply Air – Round	4-DEW	1.5”
Return Air – Rectangular	1-DIL	0.5”
Return Air – Round	4-DEW	1.5”
Exhaust Air – Rectangular	1-DIL	0.5”
Exhaust Air – Round	4-DEW	1.5”
Outdoor/Ventilation Air Supply– Rectangular	1-DIL	0.5”
Outdoor/Ventilation Air Supply- Round	4-DEW	1.5”
Exterior Ducts – Rectangular*	1-DIL/6-DEW	1”/1”
Exterior Ducts – Rectangular*	7-DEB	2”
Exterior Ducts – Rectangular*(1)	7-DEB	3”

(1) At contractor’s option, AQC Industries, R12, double-panel, pre-insulated QDuct with 2.3 mil, internal aluminum facing and 7.9 mil, external aluminum facing may be used for a SMACNA Leakage Class 1 ducts not exceeding 6,000 FPM velocity as installed per manufacturer’s specifications. Equal by Thermaduct.

*Provide 0.024” thick, aluminum jacket over insulation.

23-47 OPENINGS:

1. 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. He shall set and verify the location of sleeves as shown on structural plans that pass through beams, only if so shown.

2. Penetrations in walls for sheet metal ducts shall be sealed by the M/C 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.

23-48 ACCESS PANELS:

1. 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-inch by 6-inch.

2. Duct Access Doors: Doors shall be equivalent to CESCO Model HDD. Frame shall not be less than 22-gauge galvanized steel, with 24-gauge door panels. Doors shall have minimum 1-inch-thick insulation, PVC foam tape gaskets; zinc plated steel continuous type hinge and latches. Equivalent by American Warming and Ventilating, Cesco, Flexmaster, Greenheck, McGill Airflow, Milcor, Pottorff, Ward and Nailor will be acceptable.

3. Wall and Ceiling Access Doors: Doors shall be equivalent to Milcor DW, concealed frame, access panels. Frame shall be 26-gauge steel with a 14-gauge door panel prime coated with electrostatic powder. Lock shall be a screwdriver operated unless a keyed lock is noted on plans. Equals by Acudor, Babcock-Davis, Cesco, Elmdor, Karp, MiFab and Nystrom.

4. Fire Rated Wall/Ceiling Access Door: Doors shall be equivalent to Milcor UFR. Frame shall be 26-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. Equals by Acudor, Babcock-Davis, Cesco, Elmdor, Karp, MiFab and Nystrom.

23-49 EQUIPMENT ISOLATION:

1. Mount mechanical equipment on vibration isolators as specified. Isolator manufacturer shall supply all unit isolators, complete rails, fan, and motor bases as required, except for isolations supplied with equipment by equipment manufacturer.

2. Wherever rotational speed is mentioned as the disturbing frequency, the lowest such speed in system shall be used. Isolation devices shall be selected for uniform deflections according to distribution of weight.

3. Rubber-in-shear isolators shall be properly housed and provided with adequate facilities for bolting. Spring isolators shall be equipped with sound attenuating pads and leveling bolts and shall be free standing for deflections over 1 inch. Outside diameter of each spring when floor mounted shall be as follows:

	DEFLECTION			
	1”	1.5”	3”	3.5”
	SPRING DIAMETER			
Up to 1000#	2.5”	4.5”	5.5”	7”
1000# to 2000#	4”	5.5”	7”	8”

2000# to 3000#	5.5”	7”	8”	8”

4. Horizontal pipe runs connected to isolated equipment shall be isolated from building structure within its respective equipment room, and in other areas where specified, by isolation units designed for insertion in rods.

5. Isolation equipment which is custom designed for a manufacturer’s equipment by a reputable machinery isolation manufacturer shall be acceptable provided that the proposed equipment meets or exceeds all conditions outlined in this specification.

6. Isolation equipment shall have an installed efficiency rating of 90 percent or better.

7. Vibration isolation equipment not furnished with equipment shall be manufactured by Amber Booth Vibration Eliminator Co. Equivalent by Korfund Dynamics Corp. of Consolidated Kenetics Corp., Mason will be acceptable.

23-50 SHEET METAL WORK:

1. Provide G90 commercial quality prime, bright spangled galvanized sheet steel on all ductwork. Sheet metal shall be manufactured in the United States of America.

2. Construct ductwork as detailed on drawings and as detailed in the latest edition of the Sheet Metal and Air Conditioning Contractor’s Association (SMACNA) Duct Manual. Details shown on project plans shall indicate specific construction methods to be used on this project, and shall be used in lieu of any alternate methods shown in SMACNA Duct Manual.

3. 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.

4. Each duct system shall be constructed for the specific duct pressure classifications shown on the contract documents or in equipment fan schedule listed as external total static pressure.

5. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1 inch or 2 inches 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.

6. Construct ductwork system to conform to SMACNA Manual 23d H C Air Duct Leakage Test Manual.

7. Where dimensions, sizes, and arrangements of elements of duct assembly and support systems are not provided herein, the Contractor shall select such to be suitable for the service. All methods and devices shall be subject to the review and approval from Engineer.

8. 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 reduced fittings of ASME short flow nozzle design will be acceptable for round ductwork.

9. Provide turning vanes in all elbows over 20 degrees unless otherwise noted.

10. The Contractor shall follow the applications recommendations of the manufacturer of all hardware and accessory items and make selections of such consistent with the duct classification and services.

11. Elbows for round ductwork shall be die formed though 8-inch diameter and 5 sections elbow 9 inches and above in diameter.

12. Ducts shall be sealed in accordance with Table1-2 of SMACNA Manual 1 5d. The allowable air leakage shall be in compliance with SMACNA standards for each respective duct pressure class and duct seal class. Duct sealing shall meet the following:

1. Seal level "A" requirements shall include all transverse joints, longitudinal seams, and duct wall penetrations. Pressure-sensitive tape shall not be used.

2. Seal level “B” requirements shall include all transverse joints and longitudinal seams. Pressure-sensitive tamp shall not be used.

3. Seal level “C” requirements shall include transverse joints only.

4. Spiral lock seams in round or flat oval ducts need not be sealed.

5. Minimum duct sealant levels shall be as follows:

DUCT SEALANT LEVEL

Duct Location	Supply	Exhaust	Return
Outdoors	A	C	A
Unconditioned Spaces	B	C	B
Conditioned Spaces	C	B	C

13. All exposed round ductwork and fittings shall be double-wall, galvanized steel, spiral lock seam, with1-inch fiberglass insulation. Provide perforated inner liner instead of solid inner liner when noted on plans. Outer shell shall be “paint-grip” sheet metal. Provide double-wall round ductwork and fittings as manufactured by United McGill or approved equal.

14. At Contractor’s option, ductwork may 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.

15. All duct pressure classes shall be same as the external static pressure (ESP) of the equipment supplying the duct. The equipment ESP shall be the pressure class for the entire supply duct system.

16. All ductwork for smoke control systems shall be leak tested at 1.5 times the maximum design pressure and measured leakage shall not exceed 5%. Smoke control ductwork shall be supported directly from fire-resistance rated, structural elements of the building by substantial, noncombustible supports.

17. Dryer exhaust ducts shall be constructed of aluminum, connected with aluminum pop rivets and have a smooth interior finish:

1. Dryer exhaust ducts shall be installed per manufacturer’s recommendations.

2. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust airflow.

3. The male end of the duct at overlapped duct joints shall extend in the direction of airflow.

4. Ducts shall be a minimum nominal 4 inch diameter.

5. Each vertical riser shall be provided with a means of cleanout.

6. Exhaust terminations shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination.

7. Each dryer exhaust duct shall be provided with a dryer box for use as a dryer vent receptacle and cleanout. Dryer vent box shall be an In-O-Vent Technologies, Inc. “the dryer box”, with model 350 or 425 for upward exhaust direction or model 3D or 4D for downward exhaust direction, or approved equivalent.

23-51 SHEET METAL SPECIALTIES:

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: Aero-Dyne or equal 26-gauge HEP high efficiency profile air foil vanes mounted 2.125 inches OC on 24-gauge runners. Equals by DuctMate and Duro Dyne.

2. Control Dampers (Round – Velocities 4000 FPM and less): Provide Ruskin Model CDRS25 dampers suitable for use in temperatures from minus 50 deg F to 200 deg F. Damper shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20-gauge steel for dampers up to 24-inch diameter. Damper blades shall be two (2) layers, 14-gauge galvanized steel, and include a full-circumference neoprene seal. Leakage through damper in closed position shall not exceed 0.15 cfm per inch of blade circumference at a pressure differential of 4.0” W.G. Axle shall be 0.5-inch diameter plated steel with sleeve bearing pressed into frame. All parts not protected shall be given one coat of aluminum paint.

3. Control Dampers (Rectangular – Velocities 1000 to 4000 FPM): Provide Model CD60 low leakage dampers suitable for temperatures from minus 0 deg F to 275 deg F. Frames shall be 5-inch by 1-inch by 16-gauge galvanized steel hat channel. Blades shall be airfoil shaped and double skin construction of 14-gauge equivalent thickness and maximum of 6 inches wide. Axles shall be 0.5-inch plated steel hex. Bearings shall be molded synthetic and linkage concealed in frame. Blade edge seals shall be extruded vinyl. Jamb seals shall be flexible metal, compression type. Maximum single section size shall be 60 inches wide and 72 inches high. Provide extended shaft with bracket and locking hand quadrant. When applications require more than one (1) damper section to fill opening, sections shall be interconnected by appropriate jack shafting method. Leakage through damper in closed position shall not exceed 3.0 cfm per square foot of damper area at 1.0” W.G. static pressure.

4. Control Dampers (Rectangular – Velocities 1000 FPM and less): Provide Ruskin Model CD36 standard dampers suitable for use in temperatures from minus -25 deg F to 180 deg F. Frames shall be 5-inch by 1-inch x 16-gauge galvanized steel hat channel. Blades shall be roll formed, triple-V-groove 16-gauge galvanized steel, maximum of 6-inch wide. Axles shall be 0.5-inch plated steel hex. Bearings shall be molded synthetic and linkage concealed in frame. Maximum single section size shall be 48 inches wide and 72 inches high. Provide extended shaft with bracket and locking hand quadrant. When applications require more than one (1) damper section to fill opening, sections shall be interconnected by appropriate jack shafting. Blade edge seals shall be extruded dual durometer vinyl. Jamb seals shall be flexible metal, compression type. Leakage through damper in closed position shall not exceed 10 cfm per square foot of damper area at a pressure differential of 4.0” W.G.

5. Manual Volume Dampers (Round – Velocities 1000 to 4000 FPM): Provide Ruskin Model CDRS25 dampers suitable for use in temperatures from minus 50 deg F to 200 deg F. Damper shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20-gauge steel for dampers up to 24-inch diameter. Damper blades shall be two (2) layers, 14-gauge galvanized steel, and include a full-circumference neoprene seal. Leakage through damper in closed position shall not exceed ratings published by Ruskin. Axle shall be 3/8” diameter plated steel with sleeve bearing

pressed into frame. All parts not protected shall be given one coat of aluminum paint. Provide 2" extended stand-off bracket and locking hand quadrant.

6. Manual Volume Dampers (Round – Velocities 1000 FPM and less): Provide Ruskin Model MDRS25 dampers suitable for use in temperatures from minus 50 deg F to 250 deg F. Damper shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20-gauge steel. Damper blades shall be 20-gauge galvanized steel. Leakage through damper in closed position shall not exceed ratings published by Ruskin. Axle shall be 0.5-inch diameter plated steel with sleeve bearing pressed into frame. All parts not protected shall be given one coat of aluminum paint. Provide 2" extended stand-off bracket and locking hand quadrant.

7. Manual Volume Dampers (Rectangular – Velocities 1000 to 4000 FPM): Provide Model CD60 low leakage dampers suitable for temperatures from minus 50 deg F to 200 deg F. Frames shall be 5-inch by 1-inch by 16-gauge galvanized steel hat channel. Blades shall be airfoil shaped and double skin construction of 14-gauge equivalent thickness and maximum of 6 inches wide. Axles shall be 0.5-inch plated steel hex. Bearings shall be molded synthetic and linkage concealed in frame. Blade edge seals shall be extruded vinyl. Jamb seals shall be flexible metal, compression type. Maximum single section size shall be 60 inches wide and 72 inches high. Provide 2" extended stand-off bracket and locking hand quadrant. When applications require more than one (1) damper section to fill opening, sections shall be interconnected by appropriate jack shafting method.

8. Manual Volume Dampers (Rectangular – Velocities 1000 FPM and less): Provide Ruskin Model MD-35 standard dampers suitable for use in temperatures from minus 0 deg F to 240 deg F. Frames shall be 3-inch wide x 22-gauge or 5-inch by 1-inch x 18-gauge galvanized steel channel. Single blades shall be 22-gauge. Multiple blades shall be roll formed, triple-V-groove 18-gauge galvanized steel, maximum of 8-inch wide. Axles shall be 0.5-inch plated steel hex. Bearings shall be molded synthetic and linkage concealed in frame. Maximum single section size shall be 48 inches wide and 48 inches high. Provide 2" extended stand-off bracket and locking hand quadrant. When applications require more than one (1) damper section to fill opening, sections shall be interconnected by appropriate jack shafting.

9. Dampers shall be CESCO, Greenheck, Nailor, Prefco, Titus, United McGill, Louvers & Dampers Co., Pottorff or equal.

10. Regulators: Regulators: Metropolitan RT-100, Series III, concealed damper regulators where duct is concealed in wall or ceiling. Extend the actuator cable to behind the grille or diffuser face and anchor cable to avoid flutter. Rotary cable shall have a minimum torque service factor of 200%. Accessible cable end shall be secured with a factory furnished nylon clamp. Equal by Pottorff or Ventfabrics.

11. Counterbalanced Backdraft Dampers: Unless backdraft dampers have been specified with a piece of equipment, provide Ruskin Model CBD2 counterbalanced backdraft dampers suitable for use in temperatures to 200 deg F and pressure differentials of 40-inch W.G. for 48-inch damper widths, 6-inch W.G. for 36-inch widths, 10-inch W.G. for 24-inch widths, and 16-inch W.G. for 12-inch widths. Damper frame shall be 0.125 wall thickness 6063T5 extruded aluminum with 12-gauge steel brace at each corner. Axles shall be 0.5-inch 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. Backdraft Dampers: Provide Ruskin Model BD2/A2 backdraft dampers suitable for use in temperatures to 250 deg F and pressure differentials of 40inch for 48-inch widths. Damper frame shall be 6063T5 extruded aluminum, 0.090 inch wall thickness, mitered corners. Blades shall be 6063T5 extruded aluminum, 0.070-inch wall thickness, and extruded vinyl edge seals.

13. Flexible Connections: Ventfabrics Ventglas prefabricated flexible indoor connection of 3.25-inch-wide heat and fire resistant neoprene coated glass fabric complying with UL standard 214 with two (2) 3-inch-wide 24-gauge metal strips attached to each edge. Provide stainless steel strips on acid

exhaust fans. Indoor connector fabric shall have a minimum tensile strength of 480 lbf/inch in the warp. Ventfabrics Ventlon prefabricated flexible outdoor connection of 3.25-inch-wide heat and UV resistant Hyphalon coated glass fabric complying with UL standard 214 with two (2) 3-inch-wide 24-gauge metal strips attached to each edge. Indoor connector fabric shall have a minimum tensile strength of 530 lbf/inch in the warp and a weather-proof synthetic rubber resistant to UV rays and ozone. Provide Ventfabrics Ventel glass fabric connection with stainless steel strips on acid exhaust fans. Duro-Dyne Corporation, Ductmate, Ward Industries or approved equal will be acceptable.

14. 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-inch-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.

15. Low-pressure, flexible duct for connection to diffusers shall be Flex Master Type 1M flexible duct in accordance with NFPA, BOA, NFPA 90B, and UL 181, Class I Air Duct. Duct shall be factory insulated with flexible fiberglass insulation with a minimum R-value of 4.2 at a mean temperature of 75 deg F. The insulation shall be covered with a reinforced aluminum metalized vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, 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 deg F. Internal working pressure rating shall be at least 10 inches W.C. positive and 5 inches W.C. negative. Equivalent flexible ducts by ATCO, McGill AirFlow, Ward Industries, or approved equal. Maximum flexible duct length of run shall be 5 feet unless shown otherwise. Connections shall be either stainless steel bands or nylon straps. Provide vertical flexible ductwork elbows at diffusers with external support: Thermaflex Flexflow Elbow or approved equivalent. Contractor shall submit acoustic performance factors for flexible duct. Performance factors shall be equivalent to the flexible duct specified.

16. Round take-off fittings without dampers from medium, high, and low pressure rectangular ductwork shall be made with Buckley BMD or equal bell mouth fittings. HET (High Efficiency Takeoffs), Buckley Model 3300 or equal will be allowed, where rectangular duct depth noted on drawings is not 4 inches or greater than the round branch duct size. Round take-off fittings with dampers from medium, high, and low pressure rectangular ductwork shall be made with Buckley HD-BMD or equal bell mouth fittings. HET (High Efficiency Takeoffs), Buckley Model 3300-D-HD or equal will be allowed, where rectangular duct depth noted on drawings is not 4 inches or greater than the round branch duct size. All dampers shall be provided with extended stand-off bracket, locking handle, square damper bar, and a minimum of two U-bolts. Equivalent by Barrington, SEMCO, McGill and SMC.

17. Louvers (Stationary): Provide Ruskin ELF375DX, 6-inch deep weather louvers. Frame and blades shall be 0.081-inch thick 6063T5 alloy extruded aluminum. Blades shall be 35 deg drainable-type and spaced at 3.5-inch centers. Jambs shall be constructed with integral downspouts for carrying water from the blades to the louver sill. Screens shall be provided on the interior of the louver and shall consist of 0.5-inch mesh 0.063-inch diameter aluminum wire mounted in aluminum frame. Louvers shall pass 1100 FPM free area velocity with less than 0.19-inch water pressure drop and shall carry less than0.1 oz/sf of water during a 15 minute period when tested in accordance with AMCA 500. Louvers shall bear the AMCA certified ratings. Provide a 0.4 mils thick clear, anodized finish; alkyd prime coat following chemical cleaning and pretreatment; or 1.2 mils thick, baked enamel, painted finish with color as noted on plans. Louvers shall be Ruskin, Carnes, Louvers & Dampers, Cesco, Greenheck, Air Balance, Nailor, Prefco, Titus, United McGill and Vest Company, Pottorff or equal.

23-52 GRILLES, REGISTERS, AND DIFFUSERS:

1. Provide grilles, registers, and diffusers as shown on drawings and hereinafter specified. 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. See drawings for size and quantity.

2. Install all registers with curve of louver away from line of sight to avoid seeing into space behind louver.

3. Install all registers in masonry construction so that bottom of register starts with masonry construction joint. 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.

4. All grilles, registers, and diffusers shall be submitted with the following information for Engineers approval prior to installation. Any submittal found delinquent of requested information shall be returned for resubmittal:

1. Airflow.

2. Static Pressure Drop (maximum of 0.08-inch allowed).

3. Noise Criteria Rating (maximum of 30 NC allowed).

4. Throw – 230 FPM, 100 FPM, and 50 FPM.

5. 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 specification. Should a change be required to remain in compliance with specifications, all costs incurred shall be paid by M/C.

6. All registers and grilles shall have angled blades.

7. Equivalent by Titus, Krueger, Anemostat, Price, Nailor, or Tuttle & Bailey will be acceptable.

8. See grille, register, and diffuser schedule.

23-53 REFRIGERANT LINES:

1. Contractor shall provide all refrigerant lines. Sizing and installation of refrigerant lines shall be as recommended by E/M. All accessories required due to excessive lengths or heights shall be provided by M/C. Contractor shall submit refrigerant line sizing calculations and routing drawings/risers with equipment shop drawings.

2. All refrigerant lines shall either by Type ACR copper or pre-charged lines. Pre-charged lines shall be supplied by Refrigeration Equipment manufacturer.

3. All refrigerant lines shall be tested. Contractor shall evacuate piping system with vacuum pump, charge with refrigerant to a pressure of 10 psig, and then admit dry nitrogen until the pressure is 230 psig. Final pressure shall be left on system for a minimum of four (4) hours. After system is found to be leak free, double evacuate system the final evacuation on system a minimum of 12 hours prior to charging. Pre-charged lines need not be tested except where leaks are suspected.

23-54 EXHAUST FANS:

1. Provide exhaust fans as indicated on drawings and schedule.

2. Provide accessories as indicated on schedule.

3. All fans shall be AMCA certified for air and sound ratings.

4. Equivalents by Greenheck, Jenn Industries, Loren Cook, TwinCity Fan & Blower, or Penn Ventilation.

5. See exhaust fan schedule.

23-55 TESTING AND BALANCING PREPARATION:

1. The M/C shall prepare the system for test and balance as follows:

1. Install, start-up, check out, and adjust all HVAC systems per drawings and specifications and have fully operational with all deficiencies corrected on or before Owner's substantial completion date.

2. Verify that M/C has installed new filters no more than one day prior to starting test and balance procedure.

3. Verify that all ductwork is clean and sealed tight against leaks.

4. Verify that all controls, dampers, and actuators are installed, adjusted, and calibrated.

5. Secure control dampers after test and balance.

2. The following checks shall be performed on each system installed under this contract:

1. Air Handling Systems:

A. Clear system of all foreign objects and clean system.

B. Verify fan rotation.

C. Check bearing condition and lubrication.

D. Check fan wheel clearances and fan alignment.

E. Check motor security to mounting base.

F. Check alignment of drive.

G. Check vibration isolator adjustment.

H. Verify that proper filter media is installed.

I. Verify that all control dampers are installed and operable without binding or sticking.

J. Confirm that all fire, smoke, and volume dampers are installed and in full open position.

K. Confirm that all air openings in walls above ceilings have been provided.

L. Check for and repair all excessive air leaks in duct systems, at equipment connections and at coils. Air leaks shall not exceed SMACNA parameters for system pressure.

M. Verify that all ductwork is constructed and installed in accordance with contract drawings and/or approved ductwork shop drawings.

3. The M/C shall make changes in pulleys, belts, dampers, etc., as required by the balance contractor, at no additional cost to the Owner.

4. The M/C shall install new filters in the air handlers and clean all strainers in the water system just prior to the beginning of the test and balancing.

5. The control manufacturer, or his representative, shall assist the balance contractor in setting automatic dampers, valves, etc., as required:

1. Bring all fans to design RPM.

2. Bring air volume in each air handling system to the design air volume using Pitot tube transverse method within a minimum of 26 traverse points.

3. Test and record fan motor data.

4. Test and record static pressure and air volume in high velocity duct extremities.

5. Bring air diffusers and registers to design CFM.

6. Make recommendations for system modifications and adjustments required to facilitate proper system balancing as determined by preceding test.

7. Retest and readjust all system segments affected by system modifications.

8. Bring water systems, including pumps, to design flows.

9. Adjust return air flows where dampers are provided.

23-56 AIR AND WATER SYSTEM TESTING AND BALANCING:

1. All air supply, return and exhaust systems, and domestic hot water systems shall be balanced and adjusted to meet capacity and condition shown in construction documents. This work shall be performed by an independent testing and balancing agency certified by AABC or NEBB.

2. M/C shall submit name of testing and balancing agency to A/E for approval prior to bid performance of work.

3. Balancing shall be performed and report in accordance with latest specification for testing and balancing for air systems and hot water systems, as it pertains to systems installed on this project.

4. Balancing and test reports shall be submitted on standard AABC or NEBB forms.

5. 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 – Richard Miller (314) 567-6011.

2. Miller Certified Air – David Miller (314) 352-8981.

3. Precisionaire of the Midwest, Inc. – David Keller (816) 847-1380.

4. TABCO – Harry Gaines (417) 443-4430.

5. Total Air Balance – Bill Trotter (417) 207-9999.

6. Pro Balance – Duke Yokum (816) 228-7800.

7. C&C Group – Steve Corte (417) 429-4160.

23-57 CONDENSATE DRAINS

a) Provide as shown on drawings with materials as indicated in schedule. Condensate drains shall be trapped as required by the equipment or appliance manufacturer.

b) Piping shall be no smaller than the drain connection of the device and at least 0.75” in diameter. Piping shall not decrease in size from the drain pan to the place of condensate disposal.

c) Horizontal runs shall slope at least 1/8” per foot in the direction of discharge.

d) Piping shall be supported as required for pipe size and material to eliminate pipe sagging.

e) Provide a capped, 0.75”, cleaning port with flair fitting at each equipment connection for cleaning of drain lines.

23-58 ROOFTOP UNITS (RTU) & DEDICATED OUTSIDE AIR UNITS (DOAU):

1. MANUFACTURERS

1. Basis of Design: Daikin Applied

   A. Approved equivalent by Aaon or Trane only.

2. GENERAL DESCRIPTION

1. Furnish as shown on plans, Daikin Applied model DPS.

2. Configuration: Fabricate as detailed on prints and drawings:

3. The complete unit shall be cETLus listed.

4. The unit shall be ASHRAE 90.1-2016 compliant and labeled.

5. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

6. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

7. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

8. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

9. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at date of substantial completion.

3. CABINET, CASING, AND FRAME

1. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service

and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

2. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16” at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.

3. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

4. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

4. OUTDOOR/RETURN AIR SECTION

1. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1” differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for “free” cooling. If outdoor air is suitable for “free” cooling, the outdoor air dampers shall modulate in response to the unit’s temperature control system.

2. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include a bird screen to prevent infiltration of foreign materials and a rain lip to drain water away from the entering air stream.

3. Daikin Applied UltraSeal low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a factory installed actuator.

4. Control of the outdoor dampers shall be by a factory installed actuator. Damper actuator shall be of the modulating type. Damper to open when when supply fan starts, and close when supply fan stops.

5. Each Rooftop Unit (RTU) shall be provided with a field installed wall mounted C02 sensor. Outside air damper position will modulate between the Demand Control Ventilation Limit (minimum position setpoint) and the Ventilation Limit (maximum non-economizer position setpoint) to satisfy the space requirements. Damper position will be controlled to the greater of the two command signals, either minimum outside air flow or space IAQ (CO2).

6. Economizer assembly Fault Detection and Diagnostics (FDD) shall be 90.1, IECC, and California Title 24 compliant. MicroTech III controls shall display a warning, and write a warning to the BAS, if the economizer malfunctions in accordance with 90.1, IECC, and Title 24 specifications.

5. ENERGY RECOVERY (DOAU Units Only)

1. Each Dedicated Outside Air Unit (DOAU) shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.

2. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.

3. The DOAU unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the unit to facilitate cleaning.

4. The unit shall have 2” Merv 7 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.

5. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

6. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

7. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

8. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

9. The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust

fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor or the exhaust fan motor shall be an ECM motor. The rooftop unit shall have single point electrical power connection and shall be ETL listed.

10. The control of the energy recovery wheel shall be an integral part of the rooftop unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.

11. The DOAU unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.

6. EXHAUST FAN

1. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

2. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

3. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

7. FILTERS

1. All units shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

8. COOLING COIL

1. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

2. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

3. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

4. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

5. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

9. HOT GAS REHEAT

1. All units shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser.

2. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

3. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

4. Each coil shall be factory leak tested with high-pressure air under water.

10. SUPPLY FAN

1. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

2. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

3. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

4. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

5. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

11. HEATING SECTION

1. The rooftop unit shall include a propane gas heating section. The gas furnace design shall be one propane gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.

2. Each Rooftop Unit (RTU) module shall have two stages of heating control.

3. Each Dedicated Outside Air Unit (DOAU) module shall be complete with furnace controller and control valve capable of 10:1 modulating operation.

4. The heat exchanger tubes shall be constructed of stainless steel.

5. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

12. HEAT PUMP HEATING (DOAU Units Only)

1. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.

2. The refrigerant system shall have a pump-down cycle.

13. CONDENSING SECTION

1. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

2. Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.

3. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

4. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

5. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

6. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

7. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

8. Each circuit shall be dehydrated, and factory charged with R-410A Refrigerant and oil.

14. ELECTRICAL

1. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical

diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

2. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

3. Provide convenience receptacle that retains power when disconnect to unit is switched off.

15. CONTROLS

1. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

2. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

3. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

4. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

5. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

6. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted.

16. ROOF CURB

A. Roof curb shall be constructed of galvanized steel and be insulated. Curb height shall be 18”. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support, and air seal for the unit. Curb gasketing shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting on the rooftop unit.

B. Roof curb shall be sloped to match roof pitch and shipped fully assembled.

C. All voids within the curb shall be filled with a combination of the following;

i. Two layers of 0.5” gypsum board.

ii. One layer of 4” thick mineral wool.

iii. Two layers of 0.5” gypsum board.

D. Rooftop Unit “RTU1” and Dedicated Outside Air Unit “DOAU2” shall have vibration isolation curbs and shall include the following as a minimum;

i. The vibration eliminating portion of the assembly shall be constructed of structural steel and designed to match perfectly the bottom of the rooftop unit.

ii. The vibration eliminators shall be so designed to provide a minimum of 90% isolation efficiency with 2” deflection.

23-59 VARIABLE REFRIGERANT FLOW (VRF) HEAT PUMP / CONDENSING UNIT:

a) Warranty

1. Standard Limited Warranty

A. Manufacturer shall provide warranty that all equipment will be free from defects in material and workmanship. This warranty shall apply to compressors and all parts and is limited in duration to ten (10) years starting from the date of substantial completion.

b) Manufacturers

1. Design Basis:

A. Manufacturer shall be Daikin North America or approved equivalent by LG and Mitsubishi only.

c) HVAC System Design

1. System Description:

A. The variable capacity heat recovery air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat or cool model) system as specified.

B. The system shall consist of multiple evaporators, branch selector boxes, REFNET™ joints and headers, a three-pipe refrigeration distribution system using PID control and Daikin VRV® condenser unit.

C. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.

D. The condensing unit may connect an indoor evaporator nominal capacity up to 200% of the condensing unit nominal capacity. All zones shall each be capable of operating separately with individual temperature control.

E. A dedicated hot gas pipe shall be provided to ensure optimum heating operation performance.

F. The Daikin condensing unit shall be able to connect to indoor unit models CXTQ, FXFQ, FXHQ, FXMQ, FXLQ, FXNQ, FXSQ, FXTQ, FXDQ, FXZQ, FXUQ, FXEQ, FXAQ and FXMQ_MF, and shall range in capacity from 5,800 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each available indoor unit.

i. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.

G. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box (BSQ_T / BS_Q54T / BSF_Q54T). Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.

H. Branch selector boxes:

i. The branch selector boxes shall have the capacity to control up to 290 MBH (cooling) downstream of the branch selector box.

ii. Each branch of the branch selector box shall consist of three electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and main processor and between the box and indoor units.

iii. The branch selector box shall control the operational mode of the subordinate indoor units. The use of three EEV's ensures continuous heating during defrost (multiple condenser systems), no heating impact during changeover and reduced sound levels.

iv. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

I. Each indoor unit or group of indoor units shall be independently controlled.

2. VRV IV X Features and Benefits

A. Stable Operation – System shall provide stable inverter operation at varied ambient conditions.

B. No Drain Pan Heater – System shall be capable of heating operation without the need for a drain pan heater. If alternate manufacturer is chosen, an additional drain pan heater shall be provided by the manufacturer.

C. Auto Changeover – System shall, below the field selected outdoor ambient temperature provide signal to initiate auxiliary or back up heat.

D. Advanced Zoning - A single system shall provide for up to 64 zones.

E. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with up to 2000 positions for independent control.

F. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all “inverter” based flash vapor injection compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.

   i. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.

G. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.

   i. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.

H. Defrost Heating – Multiple condenser VRV systems shall maintain continuous heating during defrost operation. Reverse cycle (cooling mode) defrost operation shall not be permitted due to the potential reduction in space temperature.

I. Oil Return Heating – VRV systems shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.

J. Low Ambient Cooling - Each system shall be capable of low ambient cooling operation to -4°FDB (-20°CDB).

K. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve for independent control.

L. Flexible Design

   i. Systems shall be capable of up to 540ft (165m) [623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located indoor unit.

   ii. Systems shall be capable of up to 3,280ft (1,000m) total “one-way” piping in the piping network.

   iii. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.

   iv. Systems shall be capable of up to 295ft (90m) from the first REFNET™ / branch point.

   v. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.

vi. Systems shall be capable of 98ft (30m) vertical separation between indoor units.

vii. Condensing units shall be supported with a fan motor ESP up to 0.32” WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.

M. Oil return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.

N. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.

O. Space saving – Each system shall have a condensing unit module footprint no larger than 66-11/16” x 48-7/8” x 30-3/16” (1694mm x 1242mm x 767mm).

P. Each condensing unit shall include a multi-functional digital display that can provide system operation status such as operating refrigerant temperatures, pressures, outdoor electronic expansion valve opening and compressor operation time.

Q. Each condensing unit shall include a service window that can provide easy access to system field settings and operation status without completely removing the condensing unit panel.

R. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

S. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.

T. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.

U. Each system shall be capable of integrating with open protocol BACnet, LonWorks and Modbus building management systems.

V. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

d) Equipment

1. Wiring:

A. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.

B. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.

C. The control wiring maximum lengths shall be as shown below:

1.	2. **CONDENSER TO**	3. **CONDENSER TO CENTRAL**	4. **INDOOR UNIT TO**

	INDOOR UNIT	CONTROLLER	REMOTE CONTROL
5. CONTROL WIRING LENGTH	6. 6,560ft (2,000m)	7. 3,280ft (1,000m)	8. 1640 ft. (500m)
9. WIRE TYPE	10. 16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

2. Refrigerant Piping:

   A. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps or additional components.

   B. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.

      i. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

3. Paint/Corrosion Resistance:

   A. Paint and corrosion resistance shall be at a minimum per the table below:

11. **COMPONENT**	12. **VRV IV X**		
	13. **BASE MATERIAL**	14. **SURFACE TREATMENT**	15. **COATING THICKNESS** 16. **External & Internal Surface**
17. EXTERNAL PANEL BASE	18. Galvanized steel	19. POLYESTER	20. ≧1.5 mils
21. EXTERNAL FRONT PANEL	22. Galvanized steel	23. POLYESTER	24. ≧1.5 mils
25. PILLAR	26. Galvanized steel	27. POLYESTER	28. ≧1.5 mils
29. COMPRESSOR COVER	30. ASTM material	31. Resin Paint	32. ≧0. 78 mils
33. FIN GUARD	34. Iron wire	35. Resin Paint	36. ≧0. 79 mils
37. FAN GUARD AND DRUM	38. Polypropylene	39. No treatment required	40. N/A
41. FAN	42. Acrylonitrile - glass	43. No treatment required	44. N/A
45. FAN MOTOR FRAME	46. Resin	47. No treatment required	48. N/A
49. FAN MOTOR SHAFT	50. Carbon steel	51. No treatment required	52. N/A

53. FAN MOTOR SUPPORT	54. Galvanized steel	55. POLYESTER	56. ≧1.5 mils
57. HEAT EXCHANGERS (FIN ONLY)	58. Aluminum	59. Polymer Anti-corrosion surface treatment	60. Salt Spray 1000 hours, blister rating 10
61. ELECTRICAL PARTS BOX	62. Hot-dip zinc-coated steel	63. No treatment required	64. N/A
65. ELECTRICAL PARTS BOARD	66. Glass cloth / Glass nonwoven cloth material	67. Insulation Varnish	68. No specific thickness
69. SCREWS	70. Carbon steel wire rods	71. High corrosion resistance treatment	72. ≧0. 28 mils

e) OUTDOOR/CONDENSING UNIT

1. General:

A. The condensing unit is designed specifically for use with VRV series components.

B. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.

C. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.

D. High/Low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

E. The condensing unit can be wired and piped with access from the left, right, rear or bottom.

F. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.

G. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.

H. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.

I. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

J. The condensing unit shall be modular in design and should allow for side-by-side installation.

K. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

L. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.

M. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation.

N. The condensing unit shall be capable of heating operation at -13°F (-25°C) wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

O. The multiple condenser VRV systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

2. Unit Cabinet:

A. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.

B. The condensing unit shall consist of one or more propeller type, direct-drive 800W fan motors that have multiple speed operation via a DC (digitally commutating) inverter. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.

C. The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.

D. The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 7,283 CFM to 28,440 CFM dependent on model specified.

E. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

F. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

3. Sound:

A. Nominal sound pressure levels shall be as shown below.

B. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

4. Condenser Coil:

A. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.

B. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.

C. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.

D. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM B117 test standards.

E. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during operation enhancing the defrost operation.

i. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.

F. The condensing unit shall be factory equipped with condenser coil guards on all sides.

5. Compressor:

A. The Daikin inverter Flash Vapor injection scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.

i. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.

1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.

B. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “K-type”.

C. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.

i. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

D. The capacity control range shall be as low as 3% to 100%.

E. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.

F. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

G. Oil separators shall be standard with the equipment together with an intelligent oil management system.

H. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.

I. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.

J. In the case of multiple condenser modules, combined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.

f) Branch Selector Units

1. General:

A. Multi-Port Flex Branch Selector Box Series

i. The BSF8Q54TVJ is designed specifically for use with VRV IV, VRV IV X, VRV AURORA, and T-series Water Cooled heat recovery system components.

ii. These branch selector boxes shall provide individual control and changeover for multiple groups of indoor units.

iii. These branch selector boxes shall allow for Field selectable LEFT/RIGHT/PASS THROUGH piping configuration.

iv. These branch selector boxes shall allow multiple branch selector boxes to be connected downstream of the first Branch selector box in series in series.

v. These Branch selector boxes when connected in series shall be able to support a total indoor load of up to 230MBH.

vi. The EEV heads and motors used in the branch selector box shall be accessible via a quick access panel without disassembly of the electrical box.

vii. The electrical box of the 4-port branch selector box shall be field re-locatable to left, right, and back side of the main cabinet.

viii. These branch selector boxes shall allow connected indoor units to operate in cooling mode down to -4F without any additional field installed accessories.

ix. Labels shall be displayed close to the incoming 3 pipes to facilitate clear identification and eliminate cross piping.

x. The branch selector boxes shall employ EEV with the ability to control up to 6000 pulses.

xi. Selector boxes shall be factory assembled, wired, and piped.

xii. Selector boxes must be mounted indoors.

xiii. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.

2. UNIT CABINET

A. These units shall have a galvanized steel plate casing.

B. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch.

C. The cabinet shall contain one subcooling heat exchanger per branch.

D. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.

E. Nominal sound pressure levels shall be measured and published on the submittals by the manufacturer. The sound levels shall not exceed 40.5 dB(A).

F. REFRIGERANT VALVES:

i. The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

ii. The refrigerant connections must be of the braze type.

iii. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided.

iv. Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.

v. The unit shall be hermetically sealed to prevent condensation build up inside the unit, and not require use of a secondary condensate collection pan. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code, if an alternate manufacturer is selected.

G. Electrical:

i. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

23-60 VARIABLE REFRIGERANT FLOW (VRF) FAN COIL UNITS:

a) Warranty

1. Standard Limited Warranty

A. Manufacturer shall provide warranty that all equipment will be free from defects in material and workmanship. This warranty shall apply to compressors and all parts and is limited in duration to ten (10) years starting from the date of substantial completion.

b) Manufacturers

1. Design Basis:

A. Manufacturer shall be Daikin North America or approved equivalent by LG and Mitsubishi only.

c) FXSQ_TA – MSP Concealed Ducted Unit (Medium Static)

1. General: Daikin indoor unit FXSQ-TA shall be a built-in ceiling concealed fan coil unit. The unit shall be available in (11) capacities from 5,800 Btu/h to 54,000 Btu/h.

2. Unit Cabinet

A. The unit cabinet shall be constructed of heavy gauge galvanized steel.

B. The unit shall be internally insulated and shall be capable of installation in indoor environments up to 80% relative humidity without requiring additional field installed insulation.

1.

C. The unit shall ship from the factory in a rear-return configuration and shall be field-convertible to a bottom-return configuration.

D. The unit shall be equipped with a return air thermistor.

3. Fan Motor

A. The fan shall be a direct-drive, brushless DC fan motor with (3) user-selectable fan speeds (H, M, L).

B. The unit shall be equipped with internal controls to allow the fan motor to be manually adjusted, via field setting, to deliver nominal airflow CFM at a variety of external static pressures.

C. The unit shall be equipped with internal controls to allow the fan to automatically select the operating fan curve to deliver nominal airflow CFM (within +/- 10%) when the connect

ductwork has been designed with a total external static within the range of the FXSQ_TAVJU. This setting shall be accessible as a setting to be used during startup and commissioning of the system.

D. The fan motor shall be capable of Auto fan speed control when the unit is connected to the BRC1E73 Navigation Remote Control or the DCM601A71 Intelligent Touch Manager centralized control. The Auto fan speed control shall automatically adjust the unit's fan speed in response to the difference between the indoor unit's current set point and the current room temperature measurement. The Auto fan speed control shall utilize (5) fan speeds.

E. The fan motor shall be thermally protected.

F. The fan motor shall be internally isolated using rubber grommets to reduce transmission of vibrations to the unit.

4. Fan Blade

A. The fan blade shall be constructed of lightweight polymer.

B. The fan blade shall be statically and dynamically balanced to minimize vibration.

5. Coil

A. Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

B. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

C. The coil shall be 2 or 3 row cross fin copper evaporator coil with 18 fpi design, completely factory tested.

D. The refrigerant connections shall be flare connections.

E. Factory mounted thermistors shall be installed on the liquid and gas lines.

6. Condensate Drainage

A. The unit shall be equipped with a condensate drain pan under the coil.

B. The condensate drain outlet shall be of PVC construction and VP25 (1" ID, 1-1/4" OD).

C. The unit shall be equipped with a factory-integral condensate pump capable of 25-5/16" lift from the condensate drain outlet. The condensate pump shall be equipped with a float switch to automatically stop unit operation and provide a system error code in the event drain pan water level rises too high.

7. Electrical and Wiring

A. Provide a separate power supply connection of 208/230V, 1 phase, 60 hertz. The allowable voltage range shall be 187 to 253 volts.

B. Refer to the engineering data book for all other electrical data including MCA, MOCP, and FLA values.

C. The transmission (control) wiring distance between the indoor unit and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

D. The transmission (control) wiring between the indoor unit and the remote controller shall be a maximum distance of 1,640 feet.

8. Control

A. The unit shall be controlled with a Daikin remote controller to perform input functions necessary to operate the system.

B. The unit shall be compatible with interfacing with a building management system (BMS) via optional BACnet or LonWorks gateways.

C. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

d) FXFQ_T – Round Flow Sensing Ceiling Cassette Unit

1. General: Daikin indoor unit model FXFQ_T shall be a round flow ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. It shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel. The supply air is distributed via four individually motorized louvers. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72, BRC1E73, BRC2A71 and BRC1E52B7. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.

2. Performance: Each unit's performance is based on nominal operating conditions

3. Indoor Unit:

A. The Daikin indoor unit FXFQ_T shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

B. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

C. Both refrigerant lines shall be insulated from the outdoor unit.

D. The round flow supply air flow can be field modified to 23 different airflow patterns to accommodate various installation configurations including corner installations.

E. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.

F. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2" of lift from bottom of unit to top of drain piping and has a built in safety shutoff and alarm.

G. The indoor units shall be equipped with a return air thermistor.

H. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

I. The voltage range will be 253 volts maximum and 187 volts minimum.

J. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.

K. Supplied air shall be directed automatically by four individually controlled louvers.

4. Unit Cabinet:

A. The cabinet shall be space saving and shall be located into the ceiling.

B. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention and ceiling stain prevention.

C. The airflow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.

D. A branch duct knockout shall exist for branch ducting of supply air.

E. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

5. Fan:

A. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.

B. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.

C. The airflow rate shall be available in three manual settings.

D. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.

E. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.

F. The fan motor shall be thermally protected.

6. Filter:

A. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.

7. Coil:

A. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

B. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

C. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.

D. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.

E. A condensate pan with antibacterial treatment shall be located under the coil.

F. A thermistor will be located on the liquid and gas line.

8. Electrical:

A. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

B. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

C. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

9. Control:

A. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.

B. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.

C. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

D. For the Sensing functions and the optional Self-Cleaning Filter functions, Remote controller BRC1E73/BRC1E52B7 shall be used. Consult with Daikin prior to applying controls.

e) FXZQ-TAVJU –Vistatm 2x2 Cassette Unit

1. General: Daikin indoor unit model FXZQ-TAVJU shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with a decoration panel grille. It shall be available in capacities from 5,800 Btu/h to 18,000 Btu/h. Model numbers are FXZQ05TAVJU, FXZQ07TAVJU, FXZQ09TAVJU, FXZQ12TAVJU, FXZQ15TAVJU, FXZQ18TAVJU to be connected to outdoor unit model RXYQ / RXYMQ / RWEYQ / RWEQ heat pump and REYQ / RELQ / RWEYQ / RWEQ heat recovery model. The decoration panel shall be a four-way air distribution type, with fresh white (Munsell N9.5) or Daikin Silver color, impact resistant with a washable decoration panel. The

supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote controls. The indoor units sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

2. Performance: Each unit's performance is based on nominal operating conditions.

3. Indoor Unit:

   A. The Daikin indoor unit FXZQ-TAVJU shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

   B. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

   C. Both refrigerant lines shall be fully insulated from the outdoor unit or nearest branch connection into the refrigerant network.

   D. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.

   E. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.

   F. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 24-13/16" of lift, measured from the drain outlet, and has a built in safety shutoff and alarm.

   G. The indoor units shall be equipped with a return air thermistor.

   H. The indoor unit will be powered with 208~230V/1-phase/60Hz.

   I. The voltage range will be 253 volts maximum and 187 volts minimum.

4. Unit Cabinet:

   A. The cabinet shall be space saving and shall be located into the ceiling.

   B. Three auto-swing positions shall be available to choose from via field setting.

   C. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.

   D. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

5. Fan:

   A. The fan shall be driven by a direct-drive DC motor with statically and dynamically balanced impeller and shall have three user-selectable speeds available: high, medium, and low.

B. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 50W.

C. The airflow rate shall be available in high, medium, and low settings.

D. When FXZQ-TAVJU is connected with either the BRC1E73 Navigation Remote Controller or the DCM601A71 I-Touch Manager, the Auto fan mode shall be selectable.

6. Filter:

A. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

7. Coil:

A. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

B. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

C. The coil shall be a 2-row cross fin copper evaporator coil with 22 FPI design completely factory tested.

D. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.

E. A condensate pan shall be located under the coil.

F. A condensate pump with a 24-13/16” lift, measured from the drain outlet, shall be located below the coil in the condensate pan with a built in safety alarm.

G. A thermistor will be located on the liquid and gas line.

8. Electrical:

A. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

B. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

C. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

9. Control:

A. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.

B. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

f) FXEQ – One Way Blow Cassette Unit

1. General: Daikin indoor unit model FXEQ shall be a ceiling suspended cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion

valve, for installation onto a ceiling within a conditioned space. The supply air is distributed via motorized vertical and horizontal louvers which can be adjusted from 0° to 45° and 20° to 70° respectively. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E73. The indoor units sound pressure shall range from 26 dB(A) to 38 dB(A) at low speed measured at 3.3 feet below the unit.

2. Performance: Each unit's performance is based on nominal operating conditions:

3. Indoor Unit:

   A. The Daikin indoor unit FXEQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate lift pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

   B. The indoor unit shall be able to process up to 15% fresh air

   C. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

   D. Both refrigerant lines shall be insulated from the outdoor unit.

   E. Return air shall be through the flat back panel, which includes a white resin net mold resistant filter.

   F. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 33-716" of lift and has a built in safety shutoff and alarm.

   G. The indoor units shall be equipped with a return air thermistor.

   H. Motor and some of the electrical components shall be reachable through the decoration panel.

   I. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

   J. The voltage range will be 253 volts maximum and 187 volts minimum.

4. Unit Cabinet:

   A. The cabinet shall be space saving and shall be located into the ceiling.

   B. The cabinet shall be constructed with sound absorbing foamed polyurethane noise insulation.

   C. The cabinet shall be equipped with foamed polystyrene and foamed polyethylene heat insulation.

5. Fan:

   A. The fan shall be direct-drive Sirocco fan type with statically and dynamically balanced impeller with five selectable fan speeds available.

B. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.11 to 0.15 HP.

C. The airflow rate shall be available in five settings.

D. The fan motor shall be thermally protected.

6. Filter:

A. The return air shall be filtered by means of a mold resistant Resin net filter.

B. The filter shall be accessible from the decoration panel

7. Coil:

A. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

B. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

C. The coils for units up to 1 ton shall be a 2-row cross fin copper evaporator coil with 20.5 FPI design completely factory tested for the

D. The coils for units from 1.25 ton to 2.0 ton shall be 2-row cross fin copper evaporator coil with 20.5 FPI and an additional row with 15.9 FPI.

E. The refrigerant connections shall be flare connections and the condensate will be 1-1/32 inch outside diameter PVC.

F. A condensate pan with antibacterial treatment shall be located under the coil.

G. A condensate pump with a 33-7/16 inch lift shall be located below the coil in the condensate pan with a built-in safety alarm.

H. A thermistor will be located on the liquid and gas line.

8. Electrical:

A. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.

B. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

C. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

9. Control:

A. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.

B. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.

C. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

10. Standard Accessories Required:

    A. Decoration panel BYEP40AW1 shall be required for operation of FXEQ07 PVJU thru FXEQ15PVJU

    B. Decoration panel BYEP63AW1 shall be required for operation of FXEQ18PVJU and FXEQ24PVJU.

g) Intelligent Touch Manager

1. The intelligent Touch Manager (version 2.06) shall provide control for all VRV, SkyAir, and Daikin RA and FTXS indoor units with the use of the KRP928BB2S RA Adapter. It shall be capable of controlling a maximum or 64 indoor unit groups and 128 indoor units connected to a maximum of 10 outdoor units. The intelligent Touch Manager shall support operations superseding that of the local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.

2. The controller wiring shall consist of a non-polar two-wire connection to the indoor unit at terminals F1F2 (out-out) of the outdoor unit. The intelligent Touch Manager is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).

3. The intelligent Touch Manager can be used in conjunction with the BRC1E73 (Navigation Remote Controller), the BRC2A71 (Simplified Remote Controller), or the BRC4C82/7E83/7C812/7E818 (Wireless Remote Controller), BACnet interface, Lonworks interface, and Modbus adapter to control the same indoor unit groups. The remote controller shall require daisy chain wiring for grouping multiple indoor units (up to 16) together. Manual addressing is required of each remote controller group associated with the intelligent Touch Manager. DIII-NET address can be set for one (1) indoor unit or each indoor unit in the remote controller group. No more than 2 remote controllers can be placed in the same group.

4. The intelligent Touch Manager shall be equipped with two RJ-45 Ethernet ports for 100 Mbps network communication to support interconnection with a network PC via the Internet, Local Area Network (LAN), or connection with a non-networked PC after completed installation.

5. Web access functions shall be available so that facility staff can securely log into each Intelligent Touch Manager via the PC's web browser to support monitoring, scheduling, error recognition, downloading of system operation data (trend log (refer to pints list under bacnet server)) and general user functions. Error emails are also sent to designated email addresses. An additional optional software function Power Proportional Distribution (PPD) tenant billing shall also be available. The optional software shall require advanced purchase and can only be activated upon receipt of a license activation key from Daikin AC.

6. The intelligent Touch Manager shall be mounted on the wall or into the mounting fixtures included with the intelligent Touch Manager.

7. Display Features:

    A. The intelligent Touch Manager shall be approximately 11.42" x 9.57" x 1.97' in size with a backlit 10.4" LCD display.

    B. Display information shall be selectable from English, French, Italian, Korean, Dutch, Portuguese, Chinese, Japanese, German, or Spanish.

    C. Featured backlit LCD with auto off after 30 minutes (default) is adjustable between 1 to 60 minutes, or the choice of 3 different screen savers.

    D. Area and Group configuration:

8. Area contains one (1) or more Area(s) or Group(s)

   A. A. Group may be an indoor unit, Di, Dio point that has a DIII-NET address

   B. A Group may be an external management point such as a Di, Do, Bi, Bo, Bv, Ai, Ao, Av, Mi, Mo, Mv that does not have a DIII-NET address

   C. An Area is a tiered group where management points (indoor unit, digital input/output, and analog input/output 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

   D. Areas and Groups may be assigned names (ex. Office 101, Lobby, North Hallway, etc.)

   E. The Controller shall display On/Off, Operation Mode, Setpoint, Space Temperature, Louver Position, Fan Speed for each Area or Group.

   F. The Controller shall display Date (mm/dd/yyyy, yyyy/mm/dd, or dd/mm/yyyy format selectable) and day of the week along with the time of day (12hr or 24hr display selectable).

   G. The Controller shall adjust for daylight savings time (DST) automatically.

   H. Display information shall be updated every 3 seconds to show the latest status of the indoor unit groups.

   I. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Setback, Filter, Maintenance, and Screen Lock.

   J. The controller shall display the temperature setpoint in one degree increments with a range of 60oF – 90oF, 1oF basis (16oC – 32oC, 0.1oC basis).

   K. Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius

   L. Display shall reflect room temperature in one tenth degree increments with a range of-58oF – 248oF, 0.1oF basis (-50oC – 120oC, 0.1oC basis) with 0.1oC accuracy.

   M. Display of room temperature information shall be configurable for Fahrenheit or Celsius

   N. The Menu List shall be used to configure options and display information for each Area or Group.

   O. 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.

   P. System errors are generated when the intelligent Touch Manager system with other VRV controls systems are combined incorrectly or power proportional distribution calculation errors occur. The intelligent Touch Manager shall display the error with a red triangle placed on the lower task bar.

   Q. Unit errors occurring within the VRV system shall be displayed with a yellow triangle placed over the indoor unit icon

   R. 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.

S. Communication errors between the intelligent Touch Manager and the indoor units shall be displayed with a blue triangle placed over the indoor unit icon.

T. Error history shall be available for viewing for up to 500,000 errors/abnormality events with operation events.

23-61 VRF INSTALLATION QUALITY CONTROL:

1. VRF Pre-Construction Installation Meeting

1. The VRF equipment manufacturer's representative shall conduct a one-day on-site installation training session to provide training on the proper methods for installation of the entire VRF system.

A. The following parties shall be present at the meeting;

i. General Contractor's field superintendent

ii. Mechanical Contractor's foreman and pipe fitters/welders

iii. Electrical Contractor's foreman

iv. Control Contractor

2. The following parties shall be invited to the meeting at least 2 weeks in advance of the meeting date;

i. School District's maintenance staff

ii. Architect

iii. Mechanical Engineer

2. Refrigerant Piping Pressure Testing:

1. The mechanical contractor shall perform all refrigerant pressure testing per the equipment manufacturer's requirements.

2. Testing shall be witnessed and signed off by the VRF equipment manufacturer's representative.

3. All testing shall be submitted for review, prior to performing start-up of equipment.

3. Equipment Start-up:

1. The mechanical contractor shall perform equipment start-up on the complete VRF systems per the equipment manufacturer's requirements and submit reports for review.

2. The VRF equipment manufacturer's representative shall submit a letter stating that all VRF systems, components and refrigerant piping have been installed, pressure tested and started-per the VRF equipment manufacturer's requirements. Letter shall be submitted at or before date of substantial completion.

4. VRF Software and Owner Training:

1. The VRF equipment manufacturer shall provide all software required for the owner to independently service and analyze all VRF equipment and systems.

2. The VRF equipment manufacturer's representative shall provide training for a minimum of two of the owner's employees in the VRF equipment software. All associated travel costs shall be included.

23-62 BUILDING AUTOMATION SYSTEM

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.
   B. All work of this Division shall be coordinated and provided by the single HVAC Controls Contractor.
   C. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades.
   D. If the HVAC Controls Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team prior to bid.

2. HVAC CONTROLS DESCRIPTION:
   A. The work of the HVAC Controls Contractor shall be as defined in all Sections of this Division's specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
   B. The HVAC Controls Contractor shall deliver a fully functioning, networked Building Automation System (BAS) based on direct digital control (DDC) technology. The BAS system as provided shall incorporate, at minimum, the following integrated features, functions and services:
      i. Operator information, alarm management and control functions.
      ii. Enterprise-level information and control access.
      iii. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
      iv. Diagnostic monitoring and reporting of BAS system functions.
      v. Energy management
      vi. Standard applications for terminal HVAC systems.
   C. The BAS shall consist of the following:
      i. Web Server(s) and Building System Controller(s)
      ii. Equipment Controller(s)
      iii. Input/Output Module(s)
      iv. Distributed User Interface(s)
      v. Network processing, data storage and communications equipment
   D. The Marshfield School District utilizes a Tridium Niagara Facility Management Control System (FMCS) for viewing data, graphics, and providing operational status of the various temperature control systems in the district. The system covered by this specification must be capable of Interfacing with the Tridium FMCS over the schools network. Contact the school district if unclear as to the Tridium requirements.
   E. The HVAC Controls work shall consist of the providing of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned HVAC Controls System.
   F. Manage and coordinate the HVAC Controls work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

3. QUALITY ASSURANCE:

A. The HVAC Control System Contractor shall be a business that is regularly engaged in the engineering, programming, installation and service of total integrated Building Automation Systems (BAS).
B. The HVAC Control System Contractor shall be a factory authorized installer and service provider of the BAS system provided.
C. The HVAC Controls Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
D. The contractor must have been in the HVAC Controls business for at least the last ten (10) years and have successfully completed total projects of at least the same value of this contract in each of the preceding five years.
E. The DDC System architecture shall consist of the products of a manufacturer regularly engaged in the production of DDC Systems, and shall be the manufacturer's latest standard of design at the time of bid.
F. The HVAC Control Contractor shall be the following;
    i. CTS Group
        (a) 16647 Chesterfield Grove Road, Suite 200, Chesterfield, MO 63005
        (b) (636) 230-0843
G. Acceptable Manufacturers:
    i. Honeywell WEB only.
H. Workplace Safety And Hazardous Materials:
    i. The Contractor and its employees and sub-trades shall comply with federal, state and local safety regulations.

4. SUBMITTALS
    A. The HVAC controls contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
    B. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
    C. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total HVAC controls work.
    D. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the HVAC Controls Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
    E. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
    F. The HVAC Controls Contractor shall correct any errors or omissions noted in the first review.
    G. At a minimum, submit the following:
        i. DDC network architecture diagrams including all nodes and interconnections.
        ii. All XIF Files and/or all BACnet Conformance Statements verifying compatibility with the requirements of the existing Tridium Facility Management System.
        iii. Systems schematics, sequences and flow diagrams.
        iv. Points schedule for each point in the DDC system, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
        v. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
        vi. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
        vii. Details of all DDC system interfaces and connections to the work of other trades.
        viii. Product data sheets or "marked" catalog pages including part number, photo and description for all products including software.

5. CLOSEOUT DOCUMENTS
    A. Operation and Maintenance Manuals:
        i. One (1) copy of the Operation and Maintenance Manual shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance

Manual shall also be furnished on Compact Disc media, and include the following for the BAS system provided:

(a) Table of contents.
(b) As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
(c) Manufacturer's product data sheets or catalog pages for all products including software.
(d) System Operator's manuals.
(e) Archive copy of all site-specific databases and sequences.
(f) DDC system network diagrams.
(g) Interfaces to all third-party products and work by other trades.

ii. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server. Include any software required to add or remove devices, program controllers, and maintain system.

C. Furnish a backup copy of entire programming database upon completion on CD ROM. Include any software required to add or remove devices, program controllers, and maintain system.

6. WARRANTY

A. Provide a one-year labor and material warranty on the HVAC Controls System (including but not limited to DDC system).

B. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the HVAC Controls Contractor at the cost of the HVAC Controls Contractor.

C. Maintain, within 250 miles of the Project site, an adequate supply of materials for replacement of key parts and to provide labor support, including programming for warranty work.

7. SYSTEM DESCRIPTION:

A. The BAS shall use an open architecture and fully support a multi-vendor environment. The BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks. The BAS system shall be capable of integration with the existing Tridium Facility Management system in the proper communication protocol.

B. System shall be a fully functional system including all capabilities detailed in this Section and the functions described on the Drawings and in the Sequence of Operations.

C. Provide coordination between other trades fro providing and installing all equipment components, accessories, relays, thermostats, dampers, actuators, sensors, enclosures, wiring, conduit, and software required and necessary to provide control for each piece of equipment as specified in the sequence of operations. The work of this section shall be scheduled, coordinated, and interfaced with the associated work of all other trades.

D. The primary building controller(s) shall be fully IT compatible devices that communicate directly on an school system Ethernet LAN. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on the LAN.

E. The capability of providing access over the school's intranet shall be included as-installed, contingent only upon owner's provision of a valid IP address.

8. DESIGN REQUIREMENTS

A. All points of user interface shall be accessible on standard PC's that do not require the purchase of any special software. The primary point of interface on any PC shall be a standard web browser such as Internet Explorer or Mozilla Firefox. All aspects of the user interface, whether to operator workstation or to controllers, shall be via such a web browser.
B. The system shall be capable of graphic display screens to present [interactive] display of variables, setpoints, and system status. Any software required for designing graphics is to be furnished to the owner.
C. Control contractor shall provide at least one copy of any server level or administrative software required for additions of new pages, equipment, further programming, and graphics for the owner's use without license limitations.
D. Configure software to perform the following functions with proper password access through any computer within the building LAN or by authorized access via the internet.
   i. Develop, store, access, and update building management database.
   ii. Provide human operator interface with system.
   iii. Display and record system operations, including history information for all trended points. This data will consist of four data points for each piece of equipment read at one-minute intervals and saved for a 24-hour period or read at five minute intervals and saved for a 7 day period. All four points for one piece of equipment shall be presented on a one-page graph. Point selection will be provided after equipment submittals have been received.
   iv. Provide central monitoring and automatic control of building systems.
   v. Provide web server access over the Ethernet and Internet for web-based operator interface.
   vi. Web server shall reside on network with building controllers. Each standard browser connected to the server over LAN or internet shall be able to access all system information. (Programming of control options is not available on the web browser without the proper username and password credentials).
   vii. Graphic display with dynamic/animated points shall display with current data within 15 seconds and shall refresh automatically thereafter with no greater than 30 second delay.

9. PERFORMANCE REQUIREMENTS
   A. Provide a system capable of communicating functions with other building systems installed with ASHRAE 135 compatible devices.
   B. The BAS shall be designed entirely for use on Ethernet and the Internet. All networking technology used shall be off the shelf, industry standard technology fully compatible with provided networks in the facility.
   C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
   D. The existing Tridium based user interface software may be used to modify and extend the existing graphical user interface to include the added BAS architecture and associated points. All referenced points and parameters shall be available to the existing Tridium system. Modification of the existing Tridium user interface is the owner's responsibility. Cooperation and providing the associated documentation is the responsibility of this section.
   E. General
      i. The BAS shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.
      ii. All BAS features shall be accessible via Ethernet and Internet browser with equivalent BAS access control for user access.
      iii. The BAS shall support auto-dial/auto-answer communications to allow BAS Nodes to communicate with other remote BAS Nodes via standard telephone lines. All new cabling shall be Cat 5E grade, plenum rated, and installed as described in Part 3 of this Section.
      iv. Provide licenses for all licensed software residing in the BAS system and transfer these licenses to the Owner prior to completion.
      v. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network

connection shall not interrupt the execution of control strategies at other operational devices.

F. Network
   i. The BAS network shall utilize and open architecture utilizing standard Ethernet communications and operating at a minimum of speed of 100Mb/sec.
   ii. Operator workstation and control network shall communicate using TCP/IP.

G. Third party interfaces
   i. Control supplier shall integrate real-time data from fans, pumps, boilers, and other systems supplied by other trades as required.
   ii. The BAS system shall include necessary BAS hardware equipment and software to allow data communications between the BAS system and systems supplied by other trades using Lon-Talk, whether or not equipment on this Project is supplied with Lon communications. This system capability shall be available as-installed during this Project for future addition of Lon devices with no further hardware or programming required.
   iii. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the controls supplier in a timely manner at no further cost to owner to ensure complete data integration.

H. Each controller shall have a communications port for temporary connection to a laptop computer. Connection shall support memory downloads and other commissioning and troubleshooting operations.

I. System shall automatically synchronize controller time clocks daily form an operator-designated controller via the Ethernet. System shall automatically adjust for daylight savings and standard time.

J. Contractor to provide and install all new cabling and raceway as necessary to provide power and communications, to connect all elements of BAS to the server, and connections cabling between server and nearest existing Ethernet LAN hub or switch.
   i. Provide copper wiring, plenum cable, and raceways compliant with NRC and as specified.
   ii. Cabling to be minimum Cat 5E and plenum rated.

K. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions at a minimum.
   i. Log In and Log Out - System shall require user name and password to log into user interface.
   ii. Point-and-click Navigation - Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-to-click navigation.
   iii. View and Adjust Equipment Properties – Operators shall be able to view controlled equipment status and to adjust operating parameters.
   iv. View and Adjust Operating Schedules – Operators shall be able to view scheduled operating hours of each piece of equipment on a weekly or monthly calendar-based schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
   v. View and Respond to Alarms – Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
   vi. View and Configure Trends – Operators shall be able to view a trend graph of each trended point and to edit graph configurations to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
   vii. View and Configure Reports – Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
   viii. Manage Control System Hardware – Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
   ix. Manage Operator Access – Typically, only a few operators are authorized to manage operator access. Authorized operators shal be able to view a list of operators with system access and of functions they can perform while logged in. Administrative level operators shall be able to add operators, to delete operators, and to edit operator function

authorization. Administrative operators shall be able to authorize each operators function separately.

L. Software shall reside and operate in system controllers or on operator workstation. Applications shall be editable through operator web browser interface.

M. Scheduling – System shall provide the following schedule options as a minimum:
   i. Daily – Provide separate schedules for each day of the week. Each daily schedule shall be able to include a minimum of two separate occupied periods.
   ii. Exception – Operator shall be able to designate and exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.

N. Maintenance Management – System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limitations.

O. Sequencing – Sequence boilers and pumps as specified in Sequence of Operation. If sequencing/staging functionality required by Sequence of Operations for specific equipment is provided by stand-alone application specific hardware controllers or standalone system/plant controllers, BAS shall monitor and report actual conditions and functioning of each piece of equipment separately as scheduled, and report alarm condition directly from the stand-alone controller.

P. Staggered Start – Stagger restart of controlled equipment after power outage.

Q. Anti-Short Cycling – Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

R. Runtime Tracking – System shall provide an algorithm that can sum the total runtime for each binary input and output.

2.

1. BAS ARCHITECTURE:

A. Control Network:
   i. System Controllers shall provide supervisory control over the control network and shall support one of the following communication protocols:
   ii. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
   iii. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
   iv. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
   v. DDC Controllers shall reside on the control network.
   vi. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.

B. Equipment Controller:
   i. The Equipment Controllers shall be a fully user-programmable, digital controller that communicates on the Control Network.
   ii. The Equipment Controllers design shall eliminate unnecessary conflicts between control functions at crossover points in their operational sequences.
   iii. Controllers shall be fully programmable to incorporate continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately.
   iv. The Equipment Controllers shall accommodate the direct wiring of analog and binary I/O field points.
   v. The Equipment Controllers shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Control Network.

C. System Configuration Tool:
   i. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool.
   ii. The configuration tool shall provide an archive database for the configuration and application data.
   iii. The configuration tool shall have the same look-and-feel at the User Interface regardless of whether the configuration is being done online or offline.
   iv. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks.

v. The configuration tool shall be capable of programming the Field Equipment Controllers and field devices.
vi. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
vii. The configuration tool shall allow the field controller to be run in Simulation Mode to verify the applications.
viii. The configuration tool shall contain a library of standard applications to be used for configuration.

2. INPUT DEVICES:
   A. Temperature Sensors:
      i. General Requirements:
         (a) Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
         (b) The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
      ii. Room Temperature Sensors (Includes Offices, Classrooms, Libraries, APR, etc.):
         (a) Sensors shall be constructed for either surface or wall box mounting.
         (b) Room sensor shall not display the room temperature.
         (c) Setpoint slide switch or dial providing a +/- 2 deg F range (adjustable) from the room setpoint (adjustable). Marking for adjustment shall be “Warmer” or “Cooler”.
         (d) A momentary override request push button for activation of after-hours operation for two hours (adjustable).
      iii. Temperature Sensors for Vestibules, Corridors, Restrooms, etc.:
         (a) Sensors shall be constructed for either surface or wall box mounting.
         (b) Sensor shall not display the room temperature.
         (c) No adjustment or momentary override shall be provided.
      iv. Outside Air Sensors:
         (a) Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
         (b) Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
      v. Duct Mount Sensors:
         (a) Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
         (b) Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
         (c) For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
      vi. Averaging Sensors:
         (a) For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
         (b) For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
         (c) Capillary supports at the sides of the duct shall be provided to support the sensing string.
   B. Humidity Sensors:
      i. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
      ii. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
      iii. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

iv. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
v. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

C. Carbon Dioxide (CO2) Sensors
i. The sensor shall measure and transmit CO2 levels ranging from 0 to 2,000 parts per million [ppm].
ii. The transmitter shall support a linear output having a 0 to 10V or 0 to 20mA signal.
iii. The sensor shall have high accuracy and long-term measurement stability within +100 ppm over a five-year period without calibration.
iv. Outside air CO2 sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
v. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
vi. Room sensors shall be constructed for either surface or wall box mounting.

D. Smoke Detectors:
i. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

E. Status and Safety Switches:
i. Current Sensing Switches:
(a) The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
(b) Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
(c) Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
ii. Low Temperature Limit Switches:
(a) The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
(b) The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
(c) For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

3.

1. OUTPUT DEVICES:
A. Electronic Damper Actuators:
i. Manufacturer – Belimo
ii. Electronic damper actuators shall be direct shaft mount.
iii. Modulating and two-position actuators shall be provided as required by the sequence of operations. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
iv. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA.
v. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence

of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan.

B. Control Relays:
   i. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
   ii. Mounting Bases shall be snap-mount.
   iii. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
   iv. Contacts shall be rated for 10 amps at 120VAC.
   v. Relays shall have an integral indicator light and check button.

2. INSTALLATION:
   A. Responsibilities/Coordination:
      i. The HVAC Controls Contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring. The HVAC Control System Contractor shall be responsible for providing, installing, programming and commissioning a LON or BACnet BAS system which is compatible with, and prepared for integration with the School District's existing Tridium Niagara System. The installed BAS Network shall be made physically accessible at a single point.
   B. DDC System Wiring:
      i. All conduit, wiring, accessories and wiring connections required for the installation of the BAS System, as herein specified, shall be provided by the HVAC Controls Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
      ii. All BAS System wiring materials and installation methods shall comply with the system manufacturer recommendations.
      iii. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the HVAC Controls Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the HVAC Controls Contractor, the HVAC Controls Contractor shall be responsible for all costs incurred in replacing the selected components.
      iv. Class 2 Wiring:
         (a) All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified. Existing cable tray may be used where available.
         (b) Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit or in cable tray shall be supported every 5' from the building structure utilizing metal hangers designed for this application.
         (c) Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Wiring installed attached to anything other than building structure will not be allowed.
         (d) Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
         (e) Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
      v. HVAC Controls Line Voltage Power Source:
         (a) 120-volt AC circuits used for the BAS System shall be taken from panel boards and circuit breakers provided by Division 16.
         (b) Circuits used for the BAS System shall be dedicated to the BAS System and shall not be used for any other purposes.
         (c) BAS terminal unit controllers may use AC power from motor power circuits.
      vi. BAS System Wiring Raceway:
         (a) All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
         (b) Where it is not possible to conceal raceways in finished locations, metal surface raceway (Wiremold) should be used below 8'-0" AFF. Above 8'-0" AFF, EMT conduit painted to match wall may be used.

(c) All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
(d) Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

vii. BAS System Identification Standards:
(a) Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
(b) Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

viii. Input Devices:
(a) All Input devices shall be installed per the manufacturer recommendation.

ix. HVAC Output Devices:
(a) All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.

3. BAS SYSTEM VERIFICATION:
A. HVAC Controls contractor will startup the BAS system and verify proper operation. The startup procedure shall include but not be limited to the following.
i. Verification of sequences and debugging programming.
ii. Calibration of sensors and devices.
iii. Point-to-point verification of all connections.
iv. Verification of proper operation of controls components and devices.
B. Verification of system startup will be documented in the form of a startup report that the HVAC Controls contractor will submit to the Division 15 contractor, Engineer, and Owner at the completion of the system startup. The report will include a log of all systems and points verified.

4. TRAINING:
A. The HVAC Controls contractor shall provide the following training services:
i. Contractor shall participate in the Maintenance Orientations where the overall system layout and operation is described and a walk through of the facility is held to identify panel and device locations.
ii. Two 4 hours sessions (one session prior to final completion and one session six months after) of on-site or classroom orientation by a system technician who is fully knowledgeable of the control programming and specific installation details of the project.
iii. This orientation shall consist of a review of the project as-built drawings, the BAS system layout and naming conventions, and In addition, training shall enable students to accomplish the following objectives:
(a) Proficiently operate system.
(b) Understand control system architecture and configuration.
(c) Understand system components.
(d) Understand system operation, including system control and optimizing routines.
(e) Operate workstation and peripherals.
(f) Log on and off system.
(g) Access graphics, point reports, and logs.
(h) Adjust and change system setpoints and time schedules.
(i) Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools.
(j) Understand system drawings and Operation and Maintenance manual.
(k) Understand building and equipment layout and location of control components.
(l) Access data from controllers.
(m) Create, delete, and modify alarms, including configuring alarm reactions.
(n) Create, delete, and modify point trend logs (graphs) and multi-point trend graphs.
(o) Configure and run reports.
(p) Add, remove, and modify system's physical points.
(q) Add a new controller to system.

(r) Download firmware and advanced applications programming to a controller.
(s) Configure and calibrate I/O points.
(t) Maintain software to ensure latest revision or update.
(u) Add new users and understand password security procedures.
(v) Access system from remote computer over LAN or Internet, including login procedures with username and password, and IP address with full path coordinated with IT department.

END OF DIVISION 23

DIVISION 26 – ELECTRICAL – BUILDING PACKAGE

26-1 CONTRACT DOCUMENTS:

a) All contract documents including drawings, alternates, addenda, and modifications preceding this Specification Division are applicable to Electrical Contractor and his subcontractors and material suppliers.

26-2 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) When a word such as “proper,” “satisfactory,” “equivalent,” and “as directed” is used, it requires Engineer’s review.

c) “Provide” means furnish and install.

d) “Working Day” wherever used in these Specifications, shall mean the normal working days Monday through Friday, exclusive of Saturday, Sunday, and federally observed holidays.

e) Architect/Engineer hereinafter abbreviated A/E shall mean both the Design Architects and the Design Engineers.

f) Design Engineer hereinafter abbreviated D/E shall mean the engineering firm, RTM Engineering Consultants LLC., 3333 E. Battlefield Suite 1000 Springfield, MO 65804, Telephone (417) 881-0020. Contact Person: Tyler Enserro.

g) General Contractor hereinafter abbreviated G/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the general division work.

h) Electrical Contractor hereinafter abbreviated E/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the electrical division work.

i) Mechanical Contractor hereinafter abbreviated M/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the mechanical division work.

j) Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred to.

26-3 GENERAL EXTENT OF WORK:

a) Provide electrical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory for proper operation and completion of mechanical systems. In no case will claims for “Extra Work” be allowed for work about which E/C could have informed himself before bids were taken.

b) E/C 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 temperatures control electrical wiring and connections shall be part of division 26. Make required internal field wiring modifications indicated on wiring diagrams of factory installed control system 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 G/C or M/C shall be included in base bid of each respective contractor.

d) Check electrical data and wiring diagrams received from M/C for compliance with project voltages, wiring, controls, and protective devices on electrical drawings. Promptly bring discrepancies found to attention of A/E for a decision.

e) Provide safety disconnect switches, contactors, and manual and magnetic motor starters (starters are required for any motor 3/4hp or larger) for all mechanical and electrical equipment requiring such devices, whether specifically scheduled or shown on the drawings or not – no adds shall be paid for this equipment required for proper operation of the equipment after the bid. Coordinate with the M/C and omit these devices only where they are included as part of the equipment, unless scheduled otherwise on the drawings, and only where approved by the A/E. Where approval has not been obtained from the A/E prior, include all costs for this equipment in the base bid. 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) Coordinate closely with M/C and P/C for all mechanical, plumbing and/or HVAC equipment overcurrent protection. Where the provided equipment is listed with a 'Maximum Fuse Size', a fused disconnect switch shall be provided with fuses sized per the manufacturer's listing, regardless of what is shown on the drawings. Where the equipment is listed with a 'Maximum Overcurrent Protection (MOCP)', a fused or non-fused disconnect switch shall be provided as indicated and scheduled on the drawings. Include all costs as necessary for coordination with the M/C and including appropriate disconnecting means as required. Where overcurrent or disconnecting means sizes on the electrical drawings do not match the mechanical or plumbing drawings or the provided equipment, the E/C shall include costs for the larger sizes (including upsizing wiring and conduit to match overcurrent size) in the base bid. Notify the A/E in all instances.

g) Coordinate closely with M/C and P/C for all mechanical, plumbing and/or HVAC equipment electrical connection. Disconnecting means as indicated on the drawings is shown schematically. E/C shall verify mounting location and equipment connection points with the M/C and connect all equipment per the manufacturer's requirements. E/C shall verify mounting location of all disconnecting means with the E/M and install per those requirements and so as not to impact equipment performance, access, operation and/or warranty. Disconnecting means shall be installed in an accessible location as required by the National Electric Code. Provide structural supports securely attached to the building structure separate from mechanical equipment and/or supports for mounting of disconnecting means as required and include costs for all such supports and associated equipment in the base bid. Maintain all conduit and conductor feeds to equipment concealed inside the building or below grade, and stub up at the equipment inside the curb or at equipment supports. Unistrut shall <u>not</u> be allowed for any roof penetrations.

h) Coordinate closely with G/C, M/C and P/C for all electrical, lighting, mechanical, plumbing and/or HVAC equipment locations. Refer to the mechanical, plumbing and architectural plans for exact locations and quantities of all hvac equipment, plumbing equipment, smoke dampers, fire/smoke dampers, pumps, miscellaneous equipment, etc. Locations and quantities shown on the electrical drawings are approximate and may not reflect final position or quantity. The electrical contractor shall be responsible for familiarizing himself with all drawings and specifications in the construction documents, not just the electrical drawings. The electrical contractor shall provide final connection to all equipment and lighting. Where equipment or lighting is shown on the mechanical, plumbing or architectural plans but not shown on the electrical plans, electrical contractor shall provide power to the equipment based on equipment requirements as scheduled or noted, specified and/or per the manufacturer's requirements and include all costs in the base bid. Location shown of electrical connection to mechanical, plumbing or other equipment is schematic and may not reflect actual connection points. Rough-in and connection to the equipment shall be per the equipment manufacturer's requirements, the National Electric Code and as required to keep electrical connections concealed from view. All rough-in requirements shall be verified with the respective contractor and equipment manufacturer prior to any work being performed.

i) 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.

j) All electrical work as required to provide temporary power for construction shall be the responsibility of

the electrical contractor. Include all costs as required in the base bid. Coordinate and verify all requirements with the general contractor.

26-4 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.

26-5 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 the following codes, standards, or recommended practices.

1. CITY CODES:

   A. 2012 International Building Codes

   B. 2012 International Fire 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 Standards Institute ANSI A117.1.

3. NATIONAL FIRE CODES:

   A. NFPA No. 70 – National Electric Code – 2014 Edition.

   B. NFPA No. 101 – Life Safety Code – 2012 Edition.

4. UNDERWRITERS LABORATORIES, INC.:

   A. UL 508 – Standards for Industrial Control Equipment.

   B. UL 1008 – Standard for Automatic Transfer Switches.

   C. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.

c) 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, E/C shall promptly notify A/E in writing before proceeding with work so that necessary changes can be made. However, if E/C 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.

d) E/C 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 (2) copies to A/E with request for final inspection.

26-6 CONTRACT CHANGE:

a) Changes or deviations from contract; including those for extra or additional work must be submitted in writing for review of A/E. 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.

d) All submitted breakdowns shall be broken out individually for labor and material for each separate line item in the respective supplemental instruction, contract change directive, or proposal request. Items submitted with lump sums will be returned unreviewed.

e) The maximum allowable profit for any change order shall be ten percent (10%).

f) See Example below:

PRICING SHEET

Project: Project Name
Location: Project Location
Labor Rate: $22.00
Date: August 1, 2020
Estimator: Jane Doe

Material	Units	Unit Measure	Material Per Unit	Man Hours Per Unit	Total Man Hours	Materials Total
Add						
Drill & Patch Holes	1	lot	$1,285.00	3.000	3.00	$1,285.00
4” LB w/cover	6	ea	$105.23	2.750	16.50	$631.38
4” Compr. Conn	6	ea	$87.70	1.000	6.00	$526.20
4” GRC	40	ea	$9.04	0.280	11.20	$361.57
4” cut & thread labor	4	ea	$0.00	1.600	6.40	$0.00
4” GRC-PVC Adptr.	16	ea	$4.70	0.675	10.72	$75.20
4” GRC 90 Ell	4	ea	$56.34	1.500	6.00	$225.36
4” Sch 40 PVC	460	ea	$2.25	0.600	27.60	$1,034.03
Resocking Fee 20%	1	lot	$212.26	0.00	0.00	$212.26
Return Freight	1	lot	$26.40	0.000	0.000	$26.40
Deduct						
4” EMT	-330	ea	$2.46	0.045	(14.85)	($812.79)
4” EMT 90 Ell	-6	ea	$26.64	1.100	(6.60)	($159.84)
4” EMT Cplg	--39	ea	$2.27	0.270	(10.53)	($88.66)
SUBTOTAL					55.44	$3316.12
SALES TAX				6.125%		$203.11
LABOR	55.4	MH	$21.74			$1,205.27
5% OVERHEAD						$236.23
8% PROFIT						396.86
TOTAL						$5357.59

26-7 LOCATIONS AND INTERFERENCES:

a) Locations of equipment, piping, and other mechanical work are indicated diagrammatically by electrical drawings. Lay out work from dimensions on Architectural and Structural Drawings. Verify equipment

size from manufacturer's shop drawings.

b) Study and become familiar with contract drawings of other trades and in particular the 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 limitations may be permitted if reviewed by A/E 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 E/C, his subcontractor, his workmen, or by any cause whatsoever, 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 is found in error.

26-8 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.

26-9 WARRANTY:

a) E/C 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 (1) year from and after date of substantial completion of building and acceptance of mechanical systems by Owner.

b) Where manufacturers' warranties expire before or during the one-year warranty period as specified in item a, the E/C shall include provisions for extending the manufacturer's warranty as required to match the one-year period from substantial completion and shall include cost for warranty extension in his base bid.

c) E/C warrants to Owner and Architect that on receipt of written notice from either of them within one (1) 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 E/C's expense.

d) The above warranty shall not supersede any separately stated warranty or other requirements by law or by these specifications.

e) Keeps 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 (2) copies to A/E with request for final inspection.

f) If the Architect's specification includes a warranty that exceeds the above warranty requirements, the Architect's warranty shall take precedence.

26-10 MATERIALS, EQUIPMENT, AND SUBSTITUTIONS:

a) The intent of these specifications is to allow ample opportunity for E/C 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.

b) Material and equipment installed under this contract shall be first class quality, new, unused, and without damage.

c) 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 in general. Where models are listed or scheduled with information that does not match specified manufacturer's data, the larger, more expensive and/or restrictive requirement between the schedule and the manufacturer's data shall be met and included. 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. The naming of a manufacturer, or even a model number, does not alleviate the contractor from being required to meet or submit equipment which meets all of the criteria and items listed in the specifications or shown on the plans even if the specified model and/or manufacturer does not. All requirements on the drawings must be met, not just the specific model number or manufacturer. Where other than first named products are used for E/C'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, which meet or exceed the specifications, fit physically in the spaces provided, are compatible with all other systems and are acceptable to the D/E.

d) Where varying or conflicting information, notes or specifications may be shown in different locations on the drawings, schedules, or specifications, all requirements are required to be met and the worst case or more expensive and/or restrictive option should be included where duplicate information is not the same. Notify A/E for clarification.

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 A/E for review prior to procurement.

f) PRIOR TO RECEIPT OF BIDS, IF E/C WISHES TO INCORPORATE PRODUCTS OTHER THAN THOSE NAMED IN SPECIFICATIONS IN HIS BASE BID, HE SHALL SUBMIT A WRITTEN REQUEST FOR REVIEW OF SUBSTITUTIONS TO D/E NOT LESS THAN SEVEN (7) WORKING DAYS PRIOR TO BID TIME. D/E WILL REVIEW REQUESTS AND ACCEPTABLE ITEMS WILL BE LISTED IN AN ADDENDUM ISSUED TO PRINCIPAL BIDDERS.

g) 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 A/E, 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 (2) copies of complete descriptive and technical data including E/M'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 (but not limited to) adjustments in mechanical, electrical, plumbing, controls, fire alarm and/or any other service requirements necessary to accommodate such substitution; whether such affected elements are under this contract or under separate contracts.

i) Within seven (7) working days after bids are received, apparent lower bidder shall submit to A/E for approval three (3) 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, E/C shall submit shop drawings for equipment and materials to be incorporated in work, for A/E review. Where 30 day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, E/C 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:

    1. Request is received within 30 days after contract date and request includes statement showing credit due Owner, if any, if substitution products are used, or

2. Owner requests consideration be given to substitute brands.

26-11 SHOP DRAWINGS, OPERATION, AND MAINTENANCE INSTRUCTION:

a) E/C shall furnish a minimum of six (6) sets of shop drawings of all materials and equipment, A/E will retain two (2) sets.

b) 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 numbers, or letters of authorization. Each submittal shall contain at least two (2) sets of original catalog cuts. Each catalog sheet shall bear E/M's name and address. All shop drawings on materials and equipment listed by UL shall indicate UL approval on submittal.

c) E/C shall check all shop drawings to verify that they meet specifications and/or drawing requirements before forwarding submittals to the A/E for their review. All shop drawings submitted to A/E shall bear E/C approval stamp which shall indicate that E/C has reviewed submittals and that they meet specification and/or drawing requirements. E/C'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 E/C's approval shall be returned to his supplier for resubmittal.

d) No shop drawing submittals will be considered for review by the A/E without E/C's approval stamp, or that have extensive changes made on the original submittal as a result of E/C's review.

e) A/E will not be responsible for the cost of returning shop drawing submittals that are submitted to them without E/C's review and approval stamp. A letter will be sent to E/C by either the Architect or Engineer indicating receipt of an improper submittal. E/C shall acknowledge receipt of letter and indicate his plans for pick-up or resubmitting. A/E will hold improper submittals for pick-up by E/C 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 A/E.

f) A/E's review of shop drawings will not relieve E/C 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 E/C of responsibility for errors in shop drawings. No work shall be fabricated until A/E's review has been obtained. Any time delay caused by correcting and resubmitting shop drawings will be E/C's responsibility.

g) Operating and Maintenance Instructions:

1. Submit with shop drawings of equipment: copies of installation, operating, maintenance instructions, and parts list for equipment provided. Instructions shall be prepared by E/M.

2. Keep in safe place keys and wrenches furnished with equipment under this contract. Present to Owner and obtain a receipt for same upon completion of project.

3. Contractor shall provide <u>all</u> final documents including drawings, shop drawings, etc., in PDF format on a single disk to Owner. A total of five (5) CD's shall be provided, three (3) to the Owner and two (2) to A/E. No exceptions will be allowed to this requirement. Videotaping, as specified in other parts of this specification, will also be required at closeout.

26-12 PROPOSED VALUE ENGINEERING/PROJECT SCOPE REVISIONS:

a) Where design revisions are requested/required based on value-engineering or proposed changes in project scope, the contractor shall include in his proposed cost savings or adds the necessary MEP design fees that are required for modifying construction documents and associated meetings. In order

to determine that value to be included, the contractor shall submit to the A/E the proposed scope of the work required for the changes at least 7 days prior to required pricing submittal so that the design fees can be accurately determined and included. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

b) Where the contractor proposes to use different size equipment, feeders, feeder materials, circuit breakers, fuses or significant difference in routing of feeders or branches than shown in the construction documents, the contractor shall include the necessary MEP design fees that are required for modifying or creating construction drawings necessary either for construction or submission to the authority having jurisdiction and required for additional review. Design work and drawing changes will only commence once the design fee is established and a signed agreement returned to the A/E for inclusion.

26-13 CAD FILE REQUESTS:

a) CAD files are the property of the D/E. CAD files are only available upon documented written request which must be forwarded to the D/E office. Prior to receiving any CAD files, the contractor shall submit a drawing cost fee of $50 per construction drawing up to a maximum $1500. In addition, the contractor must sign a Second Party User Agreement and Drawing Request Form (available upon request from our office) which must be forwarded back to the D/E office prior to any CAD files being released. BIM/Revit models will not be made available.

26-14 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 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.

26-15 MUTILATION:

a) Mutilation of building finishes, caused by installation of electrical equipment, fixtures, outlets, and other electrical devices shall be repaired at E/C's expense to approval of Architect.

26-16 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 earth or sand and tamp to compaction required by A/E. Mechanically tamp backfill under concrete and paving in 6-inch layers to 95 percent standard density.

d) Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moisten 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 excavation. Where rock is indicated, list unit cost for rock excavation in base bid.

26-17 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, specified. Level, shim, and grout equipment bases as recommended by E/M. Mount motors, align and adjust drive shafts and belts according to E/M's instructions. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by E/C at no cost to Owner.

b) Provide concrete bases for all floor and slab mounted equipment. Refer to drawings for require base type and size. Provide 3.5-inch 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. E/C shall arrange for attachment to building structure, unless otherwise indicated on drawings or specified. Provide hangers with vibration eliminators. Contractor shall verify with structural engineer that structural members of buildings are adequate to support equipment. Submit details of hangers, platforms, and supports together with total weights of mounted equipment to structural engineer and A/E for review before proceeding with fabrication or installation.

d) Supports and/or support wires for electrical equipment, raceways, light fixtures, etc. shall be designated (painting is acceptable) separately from supports and/or support wires for other building systems. All supports and/or support wires shall be designated the same throughout the project.

26-18 START-UP, CHANGE-OVER, TRAINING, AND OPERATIONAL CHECKS:

a) E/C shall perform initial start-up of systems and equipment. Personnel qualified to start-up and service this equipment, including E/M's technicians, when specified, and Owner's operating personnel shall be present during these operations.

b) E/C 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 the total hours given each individual.

c) E/C shall report in person to Owner's operating engineer at end of first month of operation and thereafter at end of sixth and 12th 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 E/C finds that systems are not being operated and maintained as designed, he shall inform the building engineer/Owner and A/E in writing.

d) After each inspection, E/C shall submit written report to A/E indicating condition of equipment and including any recommended changes in operation of system or other information which will be helpful to Owner.

26-19 PRE-FINAL AND FINAL CONSTRUCTION REVIEW:

a) At E/C's request, A/E 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 A/E as not complete or not in accordance with requirements of contract will be outlined in report to E/C. After completion and/or correction of these items, E/C shall notify Architect project is ready for final review.

26-20 MAINTENANCE OF SYSTEMS:

a) E/C shall be responsible for operation, maintenance, and lubrication of equipment installed under his contract.

26-21 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT:

a) It shall be E/C'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) Equipment not rated for outdoor use shall be protected from moisture damage before and during construction. Covering equipment with a tarp on site is not considered a means of providing protection from moisture. Any equipment not rated for outdoor use exposed to moisture for any duration shall be replaced with new equipment at the contractor's expense.

c) Where job conditions, or work of other contractors produce the potential for damage to electrical systems and equipment, E/C shall immediately notify the G/C so that corrective action can be taken.

d) E/C 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 E/C with new equipment at no cost to Owner.

e) E/C shall periodically inspect and clean all systems and equipment to ensure all systems and equipment remain in like new condition during construction, free from dust and debris. All cleaning shall be done in accordance with E/M's recommendation where available and applicable.

f) 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.

g) All equipment requiring painting or touch-up shall be properly prepared and painted in accordance with this specification.

h) All recessed floor boxes, poke-throughs and/or floor vaults shall be fully sealed and protected from moisture, dirt, construction debris and damage during and after installation. Provide protective covers for all equipment and follow all manufacturer's installation instructions. Install only the boxes and minimum support elements initially with final inserts, electrical components and electronics to be installed at final device installation as per the manufacturer's installation instructions. Where any moisture or debris does get into the wiring compartment(s) of recessed floor boxes, poke-throughs or vaults, it shall be the contractor's responsibility to replace all interior components at his expense. Where damage is done to the recessed box frames or tops, it shall be the contractor's responsibility to cut the damaged equipment out and replace with new (all patching and repair shall be the contractor's responsibility – coordinate with G/C). Notify A/E of all instances.

i) E/C 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, E/C shall list special procedures and/or disassembly required and equipment components affected. Prior to final inspection, E/C shall submit two (2) copies of cleaning record to A/E for their records.

26-22 PAINTING OF MATERIALS AND EQUIPMENT:

a) Equipment and materials exposed to interior dry environment shall have a minimum of one (1) primer and one (1) finish coat. Equipment and materials mounted in exterior location shall have a minimum of one (1) primer and two (2) coat colors in finish areas shall be selected by A/E.

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) In all interior areas without finish ceilings, or where exposed conduit, junction boxes, hangers, supports, mounting brackets or device back-boxes are installed on walls, floors or exposed on finish ceilings, the contractor shall be responsible for painting all exposed materials to match building

finishes. Refer to the Architect's specifications for additional requirements. Colors shall be as selected by Architect.

d) Where extensive refinishing of factory applied finishes is required, equipment shall be completely repainted. A/E will make final determination of extent of refinishing required.

26-23 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, 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 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 current 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 A/E.

f) Keep a record of all deviations made from routes, locations, circuiting, etc., shown on contract drawings. Prior to final inspection, submit one (1) new set of project drawings with all deviations and change clearly indicated.

26-24 IDENTIFICATION OF WIRING AND EQUIPMENT:

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. Signs shall be weatherproof and securely attached to equipment.
TYPE 2	Self-sticking 0.5-inch-wide flexible nylon tape with high gloss surface and typed smear proof, chemical/solvent resistant lettering by Brady or Dymo.
TYPE 3	Self-sticking polyester sign with wording and size conforming to ANSI Z35.1 – 1964 and OSHA 19.0.144iii (2) specifications, by Brady or as approved.
TYPE 4	Self-sticking flexible vinyl with oil resistant adhesive for minus 20 deg F to 300 deg F temperatures by Brady or as approved.

b) Provide distribution panelboards with Type 1 signs 2 inches by 8 inches indicating panel designation, electrical characteristics and source of power. Source of power indication shall indicate source panel designation and switch or breaker number. Provide branch devices with Type 1 sign 1 inch by 4 inches indicating load served.

c) Provide lighting and power panelboards with Type 1 sign 1.25 inches by 6 inches indicating panel designation, electrical characteristics, and source of power. Source of power indication shall indicate source panel designation and switch or breaker number.

d) Provide disconnect switches, time switches, lighting contactors, motor starters, and controllers with Type 1 sign 1.25 inches by 6 inches indicating equipment served, electrical characteristics, and source of power. Source of power indication shall indicate source panel designation and switch or breaker number.

e) 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.

f) 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.

g) All electrical equipment, such as switchboards, panelboards, distribution panelboards, load centers, industrial control panels, meter socket enclosures, C/T cabinets and motor control centers shall be provided with a Type 1 sign warning persons of potential electric arc fault hazards. The sign shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing or maintenance of the equipment. Sign shall include at a minimum the orange 'WARNING' label with exclamation point symbol, and the wording "ARC FAULT HAZARD. APPROPRIATE PPE REQUIRED. FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY. REFER TO NFPA 70E."

h) All electrical equipment, such as switchboards, panelboards, distribution panelboards, load centers, industrial control panels, meter socket enclosures, C/T cabinets, motor control centers and disconnect switches shall be provided with a Type 1 sign indicating the maximum available fault current. The sign shall include the date at which the calculation was performed. This sign shall be separate from other required signs so that it is more easily replaced in the future when changes are made.

26-25 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 ensure 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:

1. Providing a PVC 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. This option can only be used where sleeve does bit communicate with supply or return air plenum.

or

2. Provide core-drilled opening in concrete with ThunderlineUnk-Seal or Calpico Sealing Linx between piping and opening.

c) 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.

d) Where electrical ducts, busses, conduits, wiring, etc., pass through fire walls, floors, and smoke partitions, seal annular space between sleeve and item passing through 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.

e) 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.

26-26 RECORD DOCUMENTS:

a) 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 print suitable titles, dates, and other identification on cover of each sheet.

b) 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, conduits, floor boxes, etc.

c) The Contractor shall provide the photographs in an 8.5-inch by 11-inch format for record keeping purposes with the maintenance manuals. The photos shall all be digital and a flash drive or CD shall be provided to the Owner as a permanent record.

d) 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.

26-27 CIRCUITING:

a) Follow circuiting shown on drawings for lighting, power, and equipment connections.

b) Shared neutrals are not allowed for any circuits fed through a dimming system.

26-28 CONDUIT APPLICATION:

a) All wiring shall be in steel conduit unless otherwise noted in this section.

b) Provide EMT conduit for the following applications:

1. All panelboard feeders above grade.

2. All branch circuits homeruns, any exposed circuits, and where required by code. Flexible conduit shall be allowed between devices in walls.

c) Non-metallic conduit shall be allowed only for the following applications:

1. Electrical service feeders below grade. Transition to steel conduit shall be made prior to coming up from below grade.

2. Branch circuits below grade. Transition to steel conduit shall be made prior to coming up from inside the concrete.

d) MC Cable shall be allowed for the following applications only (all homeruns shall be in EMT conduit):

1. Light fixture whips (maximum of 6’) and branch circuits between devices.

e) Where MC cable is noted above as allowed, it shall be installed as follows:

1. MC cable shall be allowed for light fixture whips and limited to 6’ in length. EMT is required from between fixtures.

f) Minimum homerun conduit size shall be 0.75”

g) All low voltage wiring systems (including, but not limited to temperature controls, security, access control, telephone/data, television, audio/video, fire alarm, lighting control, etc.) shall be provided with junction boxes and conduit up to above accessible lay-in ceilings, where open, plenum-rated wiring is allowed only above lay-in and/or sheetrock ceilings where wiring will be concealed from view. Where there is no ceiling (exposed structure), conduits shall be provided to conceal all wiring and all conduits shall be concealed in the building construction – exposed conduits are not allowed anywhere on the project. Temperature control wiring, security, access control, telephone/data, television, audio/video, fire alarm, lighting control, etc. wiring shall be bundled together by system and supported from the structure at regular intervals with J-hooks and additionally as required by code and the manufacturer where routed as open wiring above ceilings. Wiring shall not be routed unsupported or with straps. Fire alarm wiring shall be allowed to be open wiring as allowed by the National Electric Code above areas with lay-in or sheetrock ceilings. Provide conduit for all fire alarm wiring in all mechanical/electrical rooms, janitor's closets and storage/electrical rooms.

26-29 STEEL CONDUIT:

a) Rigid Conduit: Provide steel conduit meeting current ANSI C80.1 with hot-dipped galvanized and clear lacquer finish.

b) Electrical Metallic Tubing (EMT): Provide thinwall conduit meeting current ANSI 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 steel NO-THREAD-TYPE. Rain and concrete tight shall be used for exterior or below grade applications. Equivalent by Thomas and Betts, Appleton, O-Z Gedney, Raco, Crouse Hinds, or Steel City.

e) EMT Connectors and Couplings: Provide insulated COMPRESSION EMT TYPE. Provide insulated, concrete tight and rain tight where required for application. Equivalent by Thomas and Betts, Appleton, O-Z Gedney, Raco, Crouse Hinds, or Steel City.

f) Liquid-Tight Flexible Conduit Fittings: Appleton "STB" series insulated connectors. Equivalent by Raco, Thomas and Betts, or Crouse Hinds.

g) Provide insulated throat fittings when Type THHN/THWN conductors are installed.

h) Short runs of flexible galvanized steel conduit may be used where permitted by code. Lengths greater than 6 feet require review by Engineer.

i) 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.

j) Where conduits cross building expansion joints, provide O-Z expansion fitting Type "AX," "TE," "EX," or "EXE" as required.

k) Set screw type conduit fittings will not be allowed.

26-30 PLASTIC CONDUIT:

a) The following are general requirements for installation of plastic conduit which apply only where such plastic conduit is specifically allowed by applicable section in Division 26.

b) Normal duty applications in concrete slabs or underground without concrete encasement. Conduit shall

be CarlonPlus 40 or Carlon Plus 80, rated for use with 90 deg C conductors, UL Listed or approved equal. Material shall comply with NEMA TC-2 (conduit), TC-3 (fittings) and UL 651 (conduit) and UL514B (fittings). Conduit shall be listed UL 651 for underground and exposed use.

c) All conduit and fittings shall be solvent cemented in applications in accordance with instructions from the manufacturer.

d) Normal duty exterior underground applications direct burial: Provide semi-rigid polyvinyl chloride (PVC) Type DB plastic duct meeting current NEMA TC-6 and Western Underground Committee Specifications.

e) Normal exterior underground applications encased burial: Provide semi-rigid polyvinyl chloride (PVC) Type A plastic conduit meeting current NEMA and Western Underground Committee Specifications.

f) Provide matching plastic conduit fittings by E/M. Fittings shall meet the same standards and specifications as the conduit on which it is installed.

g) Joining and bending of conduit and installation of fittings shall be done only by methods recommended by E/M.

h) Provide conduit support spacing as recommended by E/M for the highest ambient temperature expected.

i) Provide interlocking conduit spacers by E/M or multiple runs of underground conduits installed in the same trench.

j) Ends of feeder conduit terminating at transformers, switchgear, manholes, etc., shall be terminated with bell ends to protect conductor insulation.

k) Install no plastic conduit in areas where ambient temperature may exceed 150 deg F 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.

l) 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 E/M's published charts or tables.

m) All below grade PVC conduit shall be provided with tracer wire.

n) Plastic conduit and fittings shall be by Carlon, Allied, ABB or equal.

26-31 CONDUIT INSTALLATION:

a) 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.

b) 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.

c) 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.

d) 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 NEC chapter 9, table 2. Long radius elbows may be used where necessary.

e) Ream and clean conduit before installation and plug or cover openings and boxes to keep conduit clean during construction.

f) 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, E/C 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). Where special hangers are required, submit hanger details to A/E for review before installation.

g) Where conduits cross expansion joints in building construction, the conduit system shall be provided with a means of allowing expansion/contraction in the conduit system.

h) Where a conduit or conduits enter a building from underground or from the exterior, they shall be sealed in accordance with the NEC section 300.5(G). Spare or unused conduits shall also be sealed. Sealants shall be identified for use with the cable insulation, shield or other components. Conduits (or sleeves) which will be subjected to different temperatures (such as where passing from interior to exterior, or at coolers/freezers, etc.), the conduit (or sleeve) shall be filled with an approved material to prevent the circulation of warm air to a colder section.

26-32 INSERTS AND HANGERS:

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 E/M's recommended hanger spacing.

b) Insert multiple runs of conduits as follows:

1. Where a number of conduits are to be run exposed and parallel, group and support trapeze hangers.

2. 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.

3. Inserts shall be Grinnell Figure 279, 281, 282, or 285 or equivalent as required by load and concrete thickness.

4. Provide beam clamps suitable for structural members and conditions.

5. Provide 0.375-inch minimum diameter steel hanger rods galvanized or cadmium-plated finish.

6. Trapeze hangers shall be Kindorf Series 90 channel with fittings and accessories as required.

7. Attach each conduit to trapeze hanger with Steel City No. C01 05 clamps for rigid conduit and Steel City No. C-1 06 clamps for EMT.

c) Install clamps for single conduit runs as follows:

1. Support individual runs by approved pipe straps, secured 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.

2. Install exposed conduits in damp locations with clamp backs under each conduit clamp to prevent accumulation of moisture around conduits.

3. Individual conduits suspended from ceiling shall be supported by Steel City No. C-1 49 hangers.

d) Provide inserts, hangers, and accessories with finish as follows:

1. Galvanized: Concrete inserts and pipe straps.

2. Galvanized or Cadmium Plated: Steel bolts, nuts, washers, and screws.

3. Painted with Prime Coat: Individual hangers, trapeze hangers, and rods.

e) Equivalent hanger and support systems by Grinnell, Fee and Mason, B-Line, Caddy, or Unistrut.

f) Supports and/or support wires for electrical equipment, raceways, light fixtures, etc. shall be designated (painting is acceptable) separately from supports and/or support wires for other building systems. All supports and/or support wires shall be designated the same throughout the project.

26-33 BUSHINGS AND LOCKNUTS:

a) Enter outlet boxes squarely and securely clamp conduit to outlet box with bushing on inside and locknut on outside. Provide Steel City BG series or equivalent threaded die-cast zinc insulated throat grounding bushings.

b) Terminate metallic conduits at switchboards, panelboards, control cabinet, etc., with Steel City BG series or equivalent malleable iron grounding type insulation bushings. Ground bushings to equipment grounding bus.

26-34 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 0.375-inch 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.

g) Install boxes to maintain all fire ratings, as required by the building code and NEC. At all boxes installed in fire walls throughout the project, provide fire-rated sealing assembly (refer to the other specification sections for additional locations – refer to the architectural specifications for specification of all fire-rated penetration sealing materials and/or assemblies). Putty pads and/or other fire-rated sealing assemblies, where provided, shall fully seal all boxes and conduit entries (including at the penetration into the top of the wall) and shall be installed per the manufacturer’s instructions (including minimum/maximum ambient temperatures at time of install and after installation). Submit fire penetration materials and information with the shop drawings to the architect. Refer to the other specification sections for additional requirements. Putty pads and/or fire-rated sealing assemblies shall have a minimum STC rating per the architectural specifications.

h) For telephone, data or A/V junction boxes, provide recessed type wall boxes for all outlets. Provide

complete with necessary mud-rings and components for a complete installation. Refer to plan notes for any additional requirements.

26-35 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.

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 light switch or lighting control junction boxes at 48 inches above floor to the top of the box unless otherwise called for or required by Wainscot, counter, moulding, etc – coordinate with millwork contractor and G/C prior to any rough-in. All electrical light switches shall be located as close to door frame as possible. Under no circumstances should switches be located more than 12 inches from the edge of door frames.

e) Install centerline of receptacle outlet boxes 18 inches above floor unless otherwise called for on drawings.

f) All thermostats, temperature sensors and HVAC controls shall be installed at 48” above finish floor to the top of the thermostat or sensor, on the room side of light switches where shown in the same location. None of the controls shall be higher than 48” above finish floor to the operating or visible parts.

g) Maintain minimum clearances for all boxes for proper operation of equipment (including, but not limited to, switches, fire alarm devices, temperature controls, lighting controls, receptacles, television outlets, telephone/data outlets, volume controls, A/V controls, screen switches, etc.) after they are installed – coordinate installation requirements with M/C, temperature controls contractor, owner’s A/V contractor, lighting control manufacturer and owner’s telephone/data and television system contractors prior to any rough-in to allow adequate space for all equipment. Where conflicts occur with other building components (or with light switches below these devices), notify A/E of conflict and get approval to modify box location, height or rotation prior to any rough-in. It shall be the contractor’s responsibility to relocate any boxes, conduits, wiring, etc. installed prior to coordination with any other building system.

h) If a wiring device (including, but not limited to, switches, fire alarm devices, temperature controls, lighting controls, receptacles, television outlets, telephone/data outlets, volume controls, A/V controls, screen switches, etc.) is shown to be installed in or on a column, it shall be centered on the column unless noted otherwise.

i) Locate associated data, telephone and television outlets at the same height as adjacent, associated receptacles, within 6 inches of the associated receptacles, where shown side-by-side on the plans and not noted otherwise.

j) Where wall-mounted telephone outlets are shown on the drawings in the same location as light switches, the telephone outlet shall be installed to the room side of the light switches at 48” above finish floor to the top of the telephone controls (no part of the telephone controls shall be higher than 48” above finish floor. Coordinate phone requirements with the owner prior to any rough-in).Do not locate phone outlet above the switches – locate 8” from the end of the light switches to allow clearance of the phone.

k) Where wall-mounted volume controls, A/V controls, and/or screen switches are shown on the drawings in the same location as light switches, these controls shall be installed on the room side of light switches

at 48” to the top of the box.

l) Contractor shall be responsible for coordination of all box locations with millwork, wall treatments (mats, chair rails, paneling, special systems, etc.), finishes and architectural elements to maintain full accessibility per NEC and to facilitate installation and operation of all systems. Where conflicts occur with other building components, notify A/E of conflict and get approval to modify box location or rotation prior to any rough-in. It shall be the contractor’s responsibility to relocate any boxes, conduits, wiring, etc. installed prior to coordination with any other building system.

m) Install clock and other outlet boxes at elevations indicated on drawings or as directed by A/E. Center bracket lights over mirrors with 2-inch clearance above the mirror to the bottom of the installed fixture.

n) Provide Alwalt, Keystone, Universal, or equivalent code gauge pull boxes, wireways, and gutters indicated or required for installation, sized to conform to NEC rules. Provide complete with necessary fittings, interconnecting nipples, insulating bushings, conductor supports, covers, gaskets, partitions, etc., as required.

o) Special items may be fabricated locally to same general design and specifications as those listed in specified manufacturer’s 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.

p) Where devices are installed in masonry, coordinate with A/E prior to any rough-in to allow adjustments for masonry joint locations.

26-36 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 manufacturer’s 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.

26-37 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 to color coding specified. Provide conductors No. 8 gauge and larger stranded and conductors No. 10 gauge and smaller shall be solid.

b) Use no conductors smaller than No. 12 gauge unless specifically called for or approved by D/E. Size wire for 120 volt branch circuits for 3 percent maximum voltage drop. Size feeder circuits for 2 percent maximum voltage drop. Combined voltage drop of feeders and branch circuits shall not exceed 5 percent maximum.

c) Provide conductors for listed applications as follows:

1. Lighting and Receptacle Circuits: Type THHN, 600 volt, 90 deg C (194 deg F) thermoplastic insulated building conductor.

2. Power Circuits and Feeders: Type THHN, 600 volt, 90 deg C (194 deg F) thermoplastic insulated building conductor.

3. Low Voltage and Line Voltage Conductors Sizes No. 16 and No. 18 AWG: Type TFFN, 600 volt,

90 deg C (194 deg F) thermoplastic insulated building conductor.

4. Underground Circuits and Feeders: Type THHN/TWHN, 600 volt, 75 deg C (167 deg F) wet rating and 90 deg C (194 deg F) dry rated thermosetting filled insulating cable.

d) Alcan Stabiloy compact aluminum alloy AA8000 conductors may be used in lieu of copper conductors for feeders of the size No. 1/0 AWG (copper) and larger, provided the conductors substituted will have the same current capacity (or greater) as the copper conductors specified with exceptions as follows. Aluminum conductors will not be permitted and copper conductors are required for all feeders from the main distribution panelboard/switchboard to the final connection at the equipment for all elevators, and from the main distribution panelboard/switchboard to all rooftop units, HVAC equipment, motors, elevators and electric heaters. All terminations and/or splices shall be made with approved high compression terminations – mechanical terminations will be allowed, but must be submitted for specific approval. Aluminum alloy conductors are only allowed where approved by the authority having jurisdiction – the contractor shall verify with the local authority having jurisdiction prior to submitting bids. Adds will not be allowed after the fact where a change is required. No aluminum conductors smaller than No. 1/0 shall be allowed for any purpose. Aluminum conductors shall not be allowed on any emergency or standby feeders or any circuits fed from panels that are also fed by the emergency/standby generator.

e) Provide conductors by Encore Wire and Cable, Southwire, Senator Wire and Cable, and Cerro Wire or equivalent.

26-38 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 points with insulated solderless terminal connectors. Terminate all stranded conductor terminal points with insulated solderless terminal connectors. Provide Thomas & Betts Sa-Kon insulated terminals and connectors or equivalent by API/AMP Blackburn, Buchanan, or Scotchlock.

f) Where a total of six (6) or more control and feeder conductors terminate in a multiple device panel or enclosure that has no built-in terminal blocks, provide mounting channel and see-through covers. Equivalent terminal blocks by General Electric, Square D, or approved equal.

g) Wrap conductor taps and connections requiring additional insulation with a minimum of three (3) overlapped layers of 3M Scotch vinyl plastic electrical tape No. 88 or equivalent.

26-39 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 all-weather 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	INSULATION COLOR
120/208	Neutral	White
120/208	Phase A	Black
120/208	Phase B	Blue
120/208	Phase C	Red
120/208	Phase A Switch	Brown
120/208	Phase C Switch	Yellow
120/208	Control	Pink
120/208	3-Way Sw Runner	Purple
120/208	Control	Pink
120/208	Equip. Ground	Green
120/208	Isolated Ground	Green with Yellow stripe

26-40 FUSES:

a) Provide fuses of same manufacturer and characteristics as scheduled to insure selective coordination of power system. Fuses shall be Bussmann or equivalent by Ferraz Shawmut, Eaton, Littelfuse, or Brush.

b) Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches, and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer's catalog number. Labels are supplied in fuse cartons.

c) Furnish Owner with spare fuses of each size and type installed on job as follows:

601 Amps or larger	Three (3) of each size and type.
600 Amps or less	10% with minimum of three (3) of each size and type.

d) Obtain receipt from Owner's representative showing date, quantity, and size of spare fuses delivered to Owner. Submit two (2) copies of receipt to A/E and bind one (1) copy in Owner's shop drawing manual.

e) Provide fuses with casings to match fuse holder dimensions. Fuse reducers shall not be used without prior approval of D/E.

f) Fuse shop drawings shall contain a schedule listing fuse type and size to be provided in each switch or fuse block. Also, provide a list indicating type, size, and quantity of spare fuses to be provided to Owner.

g) Fuse types shown in equipment schedules are Bussmann type designations unless otherwise indicated.

26-41 SAFETY SWITCHES:

a) Provide heavy duty and general duty horsepower rated safety switches rated in accordance with NEMA enclosed Switch Standard KS1 and UL 98 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 Eaton/Cutler-Hammer, General Electric, ITE/Siemens, or Square D.

f) See schedule.

26-42 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 built-in clearing interlocks to allow control from either momentary or maintained pilot devices.

e) Contactor shall be suitable for addition of at least two (2) 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 HOA 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 (3) 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, Eaton/Cutler-Hammer, ITE/Siemens, Square D, or General Electric.

i) See schedule.

26-43 WALL SWITCHES:

a) Provide Leviton switches with compound handles compliant with FS W-S-896 and UL20. Install groups of switches under one (1) coverplate.

b) Provide switches in colors as selection by A/E.

c) Switches controlling loads of 1800 watts or less shall be as follows unless specified otherwise:

TYPE	CATALOG #	AMP	VOLTAGE
Single Pole	LE 1221-2	20	120/277
Three Way	LE 1223-2	20	120/277
Four Way	LE 1224-2	20	120/277
Pilot Light	LE 1221-PL	20	120/277
Momentary Contact	LE 1257	20	120/277
Double Pole	LE 1222-2	20	120/277

TYPE	CATALOG #	AMP	VOLTAGE
Occupancy	HU AD2000(1/2)	20	120/277
Occupancy/Dimmer	HU LHD-IRS-3	20	120/277

d) Weatherproof switch shall have Leviton Gray coverplate and press-switch combination as follows:

TYPE	CATALOG #	AMP	VOLTAGE
Single Pole	LE 1432	15	120

e) Mount weatherproof switches in proper size FS box.

f) Where switches are shown side-by-side in the same location, or shown in the same location on the lighting and power plans separately, gang all switches together in the same box with a single coverplate (whether detailed specifically on the drawings, or not).

g) Where wall dimmers are indicated, provide on/off with slide dimmer switch, rated for the load and load type served. Follow the manufacturer's requirements. Color of switch and coverplate shall match other wiring devices.

h) Equivalent switches by Cooper Wiring, Hubbell, Pass & Seymour, Bryant, Lutron or Leviton.

i) Electric timer switches shall be Leviton Model LTB30-1LZ or Watt Stopper Model TS-200 in color to match other wiring devices.

26-44 RECEPTACLES:

a) Provide Leviton specification grade NEMA WD-1 – 1974, white in color, grounding. ALL RECEPTACLES IN CHILDCARE SPACES OR COMMON AREAS SHALL BE TAMPER RESISTANT TYPE.

TYPE	NEMA	CAT. #	AMP	VOLTAGE
Duplex	5-20R	LE 5352	20	125
Dual Voltage	5-20R/6-20R	LE 5842	20	125/250
Ground Fault	5-20R	LE 6899-A	20	125
Isolated Ground	5-20R	LE 5363-IG	20	125
GFI/TR	5-20R	LE G5362	20	125
Tamper Resistant	5-20R	LE 5362-SG	20	125
USB	5-20R	LE T5832	20	125
Weather Resistant	5-20R	LE TWR20	20	125

b) Provide Leviton weatherproof, tamper resistant receptacles with weatherproof boxes and covers as follows:

1. Install device in Leviton No. 4992 gray lift coverplate for weatherproof (WP).

2. Install device in Leviton No. IUM1V series gray "While-In-Use" cover for weatherproof in use (WPI).

c) Provide Wiremold Plugmold 2000 multi-outlet system in series as follows:

TYPE	SERIES	DESCRIPTION
1	GB	3-wire, 1-circuit; insulated grounding conductor.
2	GB2	4-wire, 2-circuit; outlets wired alternately; insulated grounding conductor.
3	DGB	3-wire, 1-circuit; duplex outlets; insulating grounding conductor.
4	IG	3-wire, 1-circuit; insulated-isolated grounding conductor.

1. Outlet spacing and length shall be as indicated on drawings.

d) Provide recessed wall boxes for all wall mounted television/monitor locations. Wall box shall be

recessed 2-gang and shall include duplex receptacle and data connection (and HDMI as indicated) equal to Legrand TV2MW or Hubbell Flat Panel Connection Enclosure or equal.

e) Equivalent receptacles by Cooper Wiring, Hubbell, Bryant, Leviton, or Pass & Seymour.

f) Provide Leviton grounding receptacles as follows:

TYPE	NEMA	CAT. #	AMP	VOLTAGE
Combination	10-30	LE 278	30	125/250
Combination	10-50	LE 279	50	125/250

h) GFCI receptacles, where indicated or required by code, shall be installed in accessible locations. They shall not be installed concealed behind equipment, in attics, above ceilings, inside electric water cooler housings, etc… Where a GFCI receptacle is shown on the drawings where it may be concealed, the contractor shall provide a GFCI circuit breaker in the panel.

26-45 FLOOR BOXES:

a) Refer to the drawings for specific floor box specifications and fire rating requirements. Provide all floor boxes with accessories and covers for a complete installation, compatible with the floor finish and type in which they are installed. Provide finish plates for all wiring devices indicated. Provide cast iron boxes, or boxes with epoxy coating for any boxes shown installed in slab-on-grade installations – boxes shall be UL listed for slab-on-grade installation. All floor boxes shall be UL listed for scrub water penetration. Include any required dividers as required to isolate power and communication compartments when devices are indicated side by side on plans.

b) Where floor boxes are shown but not specifically noted on the drawings, provide concealed service floor boxes with duplex receptacles and communication and data communication brackets as indicated on drawings. Provide gangs as necessary to accommodate the devices and quantity of devices indicated on the plans. Provide all inserts as necessary for the devices indicated and for a complete installation without leaving any unused openings. Where there are spare unused spaces in floor boxes provide blanks for all unused sections.

c) Plastic or PVC floor boxes are not approved.

d) Floor boxes shall be Wiremold model RFB-4 and/or RFB-6 recessed box with aluminum cover with tile/carpet inlay (as applicable) for concealed service box. Boxes shall be Legrand Evolution or Hubbell System One for recessed service box with flush universal cover for hard service locations. Provide poke through type for all multi-floor applications. Covers shall be aluminum finish unless indicated otherwise.

e) Equivalent floor boxes by Wiremold/Legrand, Steel City and Hubbell.

f) For installation location of floor boxes, Contractor shall refer to Architectural plans for associated furniture locations and floor system type.

26-46 FLUSH WALLPLATES:

a) Provide Leviton Type 302 stainless steel wallplates conforming to UL, NEMA and Federal Specification WP-455A.

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 (2) 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 wallplates of one design throughout the building.

h) Provide designs and finishes equivalent to above specification where wallplates for special devices are available only from manufacturer of device.

i) Verify with A/E finish of any plate where is may be apparent a special finish or color should have been specified.

j) Provide narrow wallplates as indicated.

k) Ganged wiring devices shall have a single wallplate.

l) Provide wallplates manufactured by same company as wiring devices.

26-47 LIGHTING FIXTURES:

a) Provide fixtures complete with lamps and accessories required for hanging. E/C shall ensure that lamps, reflectors, lens, and trim are clean at time of final inspection. Mount recessed fixtures with trim flush to ceilings, free of gaps or cracks.

b) Coordinate mounting of ceiling mounted lighting fixtures with G/C. Where additional ceiling or fixture supports are required due to fixture location or weight they shall be provided by E/C, unless otherwise specified under ceiling specifications.

c) Fixture lamps shall be lamp type recommended by E/M. Lamp no fixtures above E/M's recommended maximum wattages.

d) For all light fixtures in food preparation areas, the fixtures shall be provided with lensed covers or lamps that are coated and labeled as shatter resistant. Where not specifically included in the specification, the contractor shall include all provisions to comply with this requirement.

e) Consult Architectural plans for ceiling types and provide recessed fixtures and mounting components accordingly. All light fixture installation in fire rated ceilings shall comply with UL listing for rated assembly. Fixture model number shown in the schedule may not reflect correct ceiling mounting requirements – E/C shall verify with A/E prior to ordering any fixtures and include all costs in the base bid.

f) Fixture supports shall comply with NEC 410-30 and 410-36. Provide fixture securing clips as required.

g) The light fixture manufacturer shall provide a linear disconnecting means complying with NEC 410.130 for all fluorescent and double ended lamp fixtures.

h) The contractor shall replace any lamps that are not operational or burn out within first 30 days after substantial completion.

i) LED fixtures, modules, and drivers shall be listed by ANSI and tested per IESNA and ANSI for solid state lighting sources.

j) Dimmers, where required, shall be provided such that they are compatible with the LED drivers and fixtures. Provide additional wiring required between the dimming drivers and the dimmer switch/dimming system as required for proper operation (verify wiring with manufacturer from what is shown on the drawings – provide additional wiring as required and include in the base bid). Coordinate

compatibility requirements with the dimming system manufacturer and lighting fixture manufacturer prior to ordering any equipment or fixtures

k) See fixture schedule.

26-48 CIRCUIT BREAKER PANELBOARDS:

a) Provide dead-front panelboards with bolt-in or plug-on molded case circuit breakers. Panelboards shall comply with NEMA Publication PB1, UL 67 and UL50.

b) Boxes shall be galvanized steel standard width and depth except where scheduled otherwise. Fronts shall be code gauge steel finish with rust inhibiting primer and based enamel finish. Fronts shall have flush doors with flush cylinder tumbler-type locks, spring loaded door pulls, and concealed door hinges. Provide doors higher than 48 inches with three (3) point catch. Panel door locks shall be keyed alike. Provide fronts designed for flush or surface mounting as indicated and attached to box by adjustable trim clamps. Verify cover type and installation with plans and install cabinet plumb and rigid.

c) Provide tin-finished copper bars full length of panel with rating listed in schedule. Bus bar connections to branch circuit breakers shall be “Phase Sequence” type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or without removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable or copper or aluminum conductors. Provide each panel with equipment grounding bus grounded to box and neutral bus insulated from box.

d) Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall simultaneously open and close all poles of a multiple breaker. Circuit breakers shall conform to UL489 and NFPA70. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one (1) pole. Panel shall provide for branch circuit breakers up to 100 amperes, and unless indicated otherwise, shall have 10,000 RMS short circuit amperes symmetrical interrupting capacity. Breakers shall be one, two, or three pole types as indicated in panel schedule.

e) Provide breaker as type and accessories per schedule. All heat trace or electric heating circuit breakers shall be 30mA GFEP class B type breakers. All kitchen and breakroom receptacles shall be GFI or wired to GFI circuit breaker. Provide filler plate in any unused spaces.

f) Panels shall have branch circuit directory holders with clear plastic cover. Provide neatly typed circuit directory listing loads corresponding to branch circuit numbers. All panels shall have labels and arc fault indication as required in other sections of this specification.

g) Provide one spare 0.75 inch conduit for every three (3) spaces and/or blank spaces with a minimum of three (3) spare conduits per panel. Terminate conduit above ceilings unless indicated otherwise.

h) Panelboard shall be General Electric, ITE/Siemens, Square D, or Eaton/Cutler-Hammer.

i) See schedule.

26-49 CIRCUIT BREAKER DISTRIBUTION PANELBOARDS:

a) Panelboards shall be the I-Line distribution panelboards as manufactured by Square-D.

b) Provide distribution and power panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule. Panelboard shall conform to NEMA PB1, UL 67 and

UL 50.

c) Panelboard bus structure and main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50 deg C rise above ambient. Heat rise tests shall be conducted in accordance with UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests.

d) Branch circuit breakers shall be Square D FA, KA, LA, MA, NH, PA and/or PC 1-, 2-, or 3-pole molded case circuit breakers rated 15 through 2500 amperes, (120 V ac) (240 V ac) (277 v ac) (480 C ac), as specified on the drawings. Breakers shall be standard construction. All circuit breakers shall be UL and CSA listed, IEC 157-1 rated, meet UL489, and Federal Specification W-C 375B/GEN, when applicable. Molded case circuit breakers shall have over center toggle-type mechanisms, providing quick-make, quick-break action. Breakers shall be calibrated for operation in an ambient temperature of 40 deg C. Each circuit breaker shall have trip indication by handle position and shall be trip-free. 2- and 3-pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. Circuit breakers with frame sizes greater than 100 amperes shall have variable magnetic trip elements which are set by a single adjustment (to assure uniform tripping characteristics in each pole). A push-to-trip button shall be provided on the cover from mechanically tripping the circuit breaker. The circuit breaker shall have reverse connection capability and be suitable for mounting and operating in any position. Unless otherwise indicated, branch circuit breakers up to 100 amperes shall have 10,000 RMS short circuit amperes symmetrical interrupting capacity. Circuit breakers above 100 ampere shall have 42,000 RMS capacities.

e) Each panelboard, a complete unit, shall have a short circuit rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard overcurrent devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

f) Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL 50 for cabinets. The size of wiring gutters shall be in accordance with UL 67. Cabinets to be equipped with latch and tumbler-type lock on door of trim. Doors over 48 inches long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. Endwalls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electro-deposited over clean phosphatized steel.

g) The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

h) Equivalent manufacturers shall be General Electric, ITE/Siemens, Square D, or Eaton/Cutler-Hammer.

26-50 SURGE SUPPRESSION DEVICES:

a) Surge Suppression devices shall also be referred to as SPD(s).

b) Surge Protective Devices shall be provided at the following locations:

1. Each main service entrance distribution panelboard, panelboard, switchboard or disconnect switch, whether specifically shown or noted on the electrical riser diagram or plans. Where the service main is a disconnect switch, locate SPD at the first distribution or branch panelboard downstream. Where there is not a distribution panelboard or branch panelboard, tap the incoming conductors as allowed by the National Electric Code, and provide SPD with integral fused disconnecting means.

2. Any other location as noted on the electrical riser diagram or plans.

c) SPD(s) installed integral to the panelboard, distribution panelboard or switchboard shall not be allowed.

d) SPD(s) shall be provided and installed as follows:

1. Work Included:

A. Surge Suppression/Filter System: Service Entrance – High Exposure.

B. Provide a complete SPD system, including (but not limited to), an externally mounted SPD unit, all interconnecting wiring between the main bus of the panelboard and the SPD unit, all conduit and all necessary hardware or accessories necessary for a complete installation in compliance with the equipment manufacturer's requirements.

C. The contractor shall be responsible for providing a 3-pole circuit breaker in the panelboard to feed the SPD unit, whether specifically scheduled or not. The size of the breaker shall be as recommended by the SPD manufacturer for the specific equipment provided.

D. The contractor shall be responsible for all wiring between the breaker and the external SPD and it shall be sized and installed as recommend by the SPD manufacturer for optimum operation. Where the lead length exceeds 5', the contractor shall use low impedance (HPI) cable to reduce the lead length's effect on the installed performance of the SPD. HPI cable shall be provided and installed as recommended by the equipment manufacturer.

2. Quality Assurance:

A. Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in these specifications:

i. UL 1449 latest version.

ii. UL1283.

iii. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.

iv. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low Voltage AC Power Circuits.

v. UL96A.

vi. IEEE 1100 Emerald Book.

vii. National Fire Protection Association (NFPA 70, National Electric Code).

3. Submittals:

A. Package must include shop drawings complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list, warranty, and wiring configuration.

4. Products:

A. Unless noted otherwise on the drawings (plans or riser), provide the model TG3-100-[voltage]-3GY-MN-[feed per field conditions]-M2-F-2 by Current Technology and model CGP-80-[voltage] for branch panels.

B. Equivalents allowed by National Lightning Protection, Square D, ASCO and Innovative Technology/Eaton provided all requirements of the specifications below are met and submitted prior.

C. TVSS shall meet all the requirements and test procedures as outlined in NEMA LS-1 Standards "LOW VOLTAGE SURGE PROTECTIVE DEVICES". The unit shall be tested as a complete unit, with all fuses in place. A unit tested without fuses shall be considered as not compliant to NEMA LS-1. TVSS shall meet the following minimum requirements:

i. Nominal voltage rating shall be three-phase, four-wire to match the main panel/switchboard voltage.

ii. Protection Method: MOV.

iii. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL 1449 latest edition. Each thermally protected MOV shall have end of life indicator and system shall be self monitoring. Unit with end of life short circuit is not acceptable.

iv. Each MOV shall be separately fused. Fuses shall be UL 248 listed. All shall be UL listed for type 1 and type 2 SPD applications. Surge current 150 (L-N) for 208V, 320 (L-N) for 480V.

(a) Service entrance location rated to 200-240kA.

(b) Distribution locations rated to 120-160kA.

(c) Branch locations rated to 80-100kA.

v. EMI/RFI High Frequency Noise Filter Ratings: each unit shall include a high performance EMI/RFI noise rejection filter with a maximum attenuation of 50dB for 10-100MHz. The EMI/RFI noise rejection filter shall be included for all L-N modes shall include a removable filter in the N-G mode.

vi. Enclosure shall be NEMA 3R rated where installed outdoors, NEMA 1 rated where installed indoors, unless noted otherwise. Refer to the plans for location.

vii. Provide Standard monitoring system to include LED/phase indicators, audible alarm, dry relay contacts and a surge counter.

e) Installation, Start-up and Warranty:

1. Follow all manufacturer's installation instructions and requirements.

2. The SPD system shall be provided with a minimum 10-year warranty from the time of substantial completion.

3. Surge Protectors shall be installed as close as practical to the electrical panel or dedicated electronic equipment to be protected. The SPD shall be close connected to the panel in a position near the panel board neutral bus bar or positioned so that the overall lead length will be minimal. Taps shall comply with NEC for compliance.

4. The Surge Protector shall be installed in a manner consistent with proper and acceptable industry wiring practice. SPD connection leads shall be as short and straight as possible while avoiding sharp bends.

5. Surge Protectors provided with terminals shall be wired with stranded conductor size permitted

within rating of lugs. Wire from circuit breaker to surge protector shall be installed in accordance with the National Electric Code and equipment manufacturer.

6. Local Factory representative shall perform start up and testing and shall supply written documentation of test. SPD's shall be energized after power system have been energized, stabilized and tested.

26-51 CAPACITORS:

a) Provide indoor dust-proof or outdoor weatherproof capacitors of capacity and rating listed in schedule.

b) Capacitor, KVAR listed are nominal size required to provide 95 percent power factor for motor speed and horsepower specified. E/C shall verify with E/M of motors provided, the required KVAR to correct motor power factor to 95 percent. Cost for additional capacitor KVAR above KVAR specified shall be responsibility of contractor providing motor.

c) Capacitors on 208 volt systems shall be rated at 208 volts and have KVAR at 208 volts listed on name plate.

d) Provide capacitors with solderless line and ground terminal connectors mounted inside a bolt-on terminal compartment with gasketed cover.

e) Provide each capacitor with internal discharge resistor conforming to NEMA standards. Residual voltage (after circuit is de-energized) shall be less than 50 volts within one minute.

f) Provide capacitors meeting above specification by General Electric, Sprague, or Westinghouse.

g) See schedule.

26-52 GROUNDING:

a) Supplement grounded neutral of secondary distribution system with equipment grounding system, installed so that metallic structures, enclosures, raceways, junction 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 NEC section 250, 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) 0.75-inch diameter by 10-foot ground rods. Where extra rods are necessary to meet requirements of specified tests, E/C shall be reimbursed for additional cost. Rods shall be located a minimum of 6 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. Ground rods shall be driven 2" below finish floor or grade unless otherwise indicated.

c) Ground all metallic water piping systems (domestic water, chilled/hot water, condenser water, etc.) in the building to electrical service ground with a minimum 3/0 or as required green insulated copper ground conductor, in conduit. Where a dielectric fitting is installed anywhere in the system, or where a non-conductive fitting is installed, the piping system on each side of the fitting shall be separately bonded. On the main water service, connect ground conductor to building side of dielectric water fittings. Do not install jumpers around dielectric water fittings. Bond piping to ground conductor at each end. Provide 3/0 jumper with ground clamps around water meter. Coordinate with mechanical contractor and include all associated costs in the base bid.

d) Connect system neutral ground and equipment ground system to common ground bus.

e) Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with NEC. 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.

f) Required equipment grounding conductors and straps shall be sized in compliance with NEC Table 250-66. 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.

g) Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or 3-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.

h) 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 singe phase branch circuits with suitable green insulated grounding conductors. Single phase branch circuits required for special equipment, such as X-ray, etc., 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.

i) E/C 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. E/C/ responsible for grounding of all CATV, phone, and telecommunication systems per NEC. Coordinate with system provider.

j) 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.

k) Provide non-metallic conduits or ducts with equipment grounding conductors except for conditions as follows:

    1. Where medium voltage multi-conductor (2.3 KV and above) cable is equipped with a metallic sheath, or cable is provided with ground conductors and bonded to non-current carrying metallic equipment at both ends.

    2. Where ducts are for telephone or communication uses only.

l) 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.

m) Provide electric devices such as air cleaners or heater control switches, 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.

n) 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.

o) 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.

p) 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-inch long, 0.75-inch copper clad ground rod driven in ground.

q) Test complete equipment grounding system to each service disconnect enclosure ground bar in accordance with IEEE81. Submit certified test reports of compliance with 5 ohm measured ground resistance value.

r) Provide a No. 6 ground conductor to all telephone/computer/television/audio/visual racks in all telephone equipment rooms (and where indicated in the contract documents) whether specifically shown or noted on the drawings. Provide a minimum of 60 inches of free wire at the termination for connection to owner-provided racks. Coordinate exact location and requirements with the owner prior to any rough-in. Provide 0.25”x4” grounding bus bar with holes 0.28 holes spaced 1.125” apart for all main IT rooms. Include mechanical type, cast silicon bronze, solderless terminals and UL891 listed stand-off insulators rated for 600V.

s) All equipment and panel grounds shall be bonded to a common building ground system per the National Electric Code, whether specifically shown on the electrical riser diagram or not. This includes all of the separately derived systems in the building (transformers) that are required to bond to the nearest grounding electrode. This shall be provided per section 250.30 of the NEC, by the electrical contractor and included in the base bid. Comply with all requirements be local authority having jurisdiction.

26-53 CABLE TRAY:

a) Cable tray shall be a welded wire mesh cable management system. Welded wire mesh shall be 2” x 4” with a minimum wire diameter of 0.197”, meeting ASTM A510, ASTM A569 and ASTM A570.All components shall be electroplated zinc galvanized to .8 mil, meeting ASTM B633 or in color per plans were noted. Reference electrical plans for sizing.

b) Cable tray shall have the compatibility of being suspended or wall mounted with full bottom support (center rod support is not acceptable). Entire cable tray system shall be by one manufacturer. Contractor shall follow manufacturer’s instructions for installation.

c) All intersections or transitions shall be radiused, to facilitate cable installation. Where cable tray penetrates a wall where exposed structure, provide trim around wall penetration. Where walls are white, fill opening in cable tray with white mineral wool or equal product.

d) Cable tray shall be UL listed with a three (3) year warranty and made in the United States.

e) Acceptable manufacturers are Flextray, Cablofil, B-Line, Hubbell and MP Husky or by prior approval only.

f) No cable tray shall exceed 50 percent fill. Coordinate sizes with low voltage wiring utilizing tray. All wiring shall be organized by type the cable tray for professional installation.

g) All cable tray shall be installed and grounded in accordance with the NEC and all local codes.

h) Furnish and install EZ-Path fire rated wiring devices and associated hardware as shown on the Contract Drawings or as required in all corridor/hallway fire rated walls and as hereinafter specified as manufactured by Specified Technologies, Inc. or equal. All devices shall be UL listed and tested in accordance with ASTME814. Equivalent by Wiremold Flamestopper or by prior approval only.

    1. All devices shall be heavy-duty specification grade with an intumescent insert material allowing for 0 to 100-percent visual fill of conductors.

    2. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires

and data cables required.

3. Install per manufacturer recommendations at all fire rated walls where cable tray butts up to wall.

26-54 LIGHTING CONTROL DEVICES:

a) Work Included:

1. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, low voltage cable and wiring, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational local lighting control system, as described herein.

b) System:

1. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area or otherwise controlled from daylighting or other room sensors.

   A. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor. Submit any interconnection diagrams per major subsystem showing proper wiring.

   B. Components shall communicate via low voltage wiring and wired per manufacturer’s instructions. Cabling shall be plenum rated where installed above accessible ceilings. Cabling in walls, above non-accessible ceilings, and in exposed areas shall be in conduit.

   C. Provide emergency shunt replays as noted for operation as normally closed, electrically held relay for manual or automatic switch complying with UL924 for voltage matching lighting circuit.

c) Where required, provide a local DLM network to provide physical connection and communication protocol designed to control a small area of a building. Features of the DLM local network include:

1. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
2. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
3. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

d) Products:

1. Load Controllers (Room, Plug Load, and Fixture Controllers):

   A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/ potentiometers, or require special configuration for standard Plug n' Go applications. Each load controller shall be programmed to meet the sequence of controls shown on the drawings.

   B. Fixture Controllers:

i. A form factor and product ratings to allow various OEM fixture manufacturers to mount the device inside the ballast/driver cavity of standard-sized fluorescent or LED general lighting fixtures.

ii. One 3A 120/277V rated mechanically held relay.

iii. Programmable behavior on power up following the loss of normal power.

iv. Provide power from nearest room controller to operate fixture controller if not shown on drawings.

v. 0-10V dimming capability via a single 0-10 volt analog output from the device for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Fixture Controller.

vi. Refer to lighting device schedule.

2. Occupancy or Vacancy Sensors (Ceiling, Wall, or Wall Switch type):

A. Program sensors to meet the sequence of controls shown on the drawings. In general, occupancy mode shall mean automatic-on/automatic-off operation and vacancy mode shall mean manual-on/automatic-off operation with field capability to switch operation. Sensors shall have bypass switch to override “on” function in event of sensor failure. Sensors shall have the following functionality:

i. Time delay adjustment from 1-15 minutes in 1 minute increments, test mode, and walk-through mode.

ii. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.

iii. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. Retrigger mode can be programmed to use ultrasonic (US) and/or passive infrared (PIR).

iv. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

B. Provide and wire through power pack as required. Provide dual technology type unless PIR or Ultrasonic is otherwise indicated.

C. Device shall be suitable for mounting on standard outlet box. Relays shall be externally mounted in standard electrical enclosure. Time delay and sensitivity adjustments shall be recessed and concealed behind hinged door.

D. Provide switch sensor type as indicated. Switch sensors shall have 180 degree field of view, field adjustable from 180 to 40 degree, capable of 3-way operation, have override button, and have field adjustable time delay selector.

E. Digital occupancy/vacancy sensors shall provide graphic LCD display for digital calibration and electronic documentation where noted.

(a) Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls as required.

ii. Device Status LEDs, which may be disabled for selected applications.

iii. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

iv. Manual override of controlled loads.

v. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

vi. BACnet object information.

vii. Refer to lighting device schedule.

3. Digital Wall Switches:

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration with programmable control functionality. Device color and plate shall match as required in other sections of the specification.

B. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

C. BACnet object information.

D. Switches shall be capable of manually overriding photosensors, occupancy sensors, or time controls. See plans for the sequence of controls. Provide quantity of switches as required to meet design intent.

E. Refer to lighting device schedule.

e) Installation:

1. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

2. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

3. Provide wiring per manufacturer recommendations and install as required in other specification sections.

4. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems. Locations shown on plans are schematic and shall be modified as required in field to accommodate obstructions and undesired exposures.

5. Contractor shall test, program, and adjust equipment as required and shall include complete installation and startup checks according to manufacturer's written instructions. When requested,

the contractor shall provide one additional follow up trip for programming adjustments after substantial completion and initial system adjustments as noted during owner walk-thru.

6. Equivalent manufacturer by Wattstopper, Leviton, Greengate, and Hubbell or by prior approval only.

26-55 FIRE ALARM SYSTEM:

a) Related Documents:

1. Drawings and general provisions of the contract including general and supplementary conditions and Division 1 specification sections, apply to this section.

2. Requirements of the following Division 26 sections apply to this section.

A. “26 – Electrical Requirements.”

B. The complete installation is to conform to the applicable sections of NFPA 72 and the NEC with particular attention to Article 760.

C. NFPA 101 – Life Safety Code.

b) Summary:

1. This section includes fire alarm systems, including manual stations, detectors, notification appliances, signal equipment, controls, smoke control and devices.

2. Work covered by this specification section includes the furnishing of labor, equipment, materials, and complete operational performance required for installation of the fire alarm system as shown on the drawings, as specified, and as directed by the A/E.

3. The work covered by this section of the specification is to be coordinated with the related work as specified elsewhere under the project specifications.

4. The fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions:

A. Fire alarm and detection operations.

B. Remote manual and automatic control of elevators, door hold-open devices, fire suppression appliances, and/or off-premise notification.

C. Dual line DACT communicator with modem for external, remote supervision monitoring coordinated with owner’s current supervision system if applicable. Communication protocol shall be compliant with NFPA.

c) System Descriptions:

1. General: Complete, non-coded, addressable, microprocessor-based fire detection and voice annunciation system with manual and automatic alarm initiation. Fire signal initiation shall be from pull stations, heat detectors, smoke detectors, duct smoke detectors, gas detectors, flow switch, tamper switches, etc as required by code and indicated on plans. Notification shall operate speaker notification appliances, identify initiating devices, transit signals to remote receiving location, release fire/smoke doors held by magnetic holders, activate alarm/voice system as applicable, and control any hvac equipment controls or dampers, smoke control systems or any other applicable systems in the building. Include all work and notification for supervisory and trouble signals per NFPA.

2. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

   A. Automatic Voice Evacuation Sequence:

      i. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.

      ii. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

      iii. Speaker: Speaker notification appliances shall be listed to UL 1480.

      iv. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.

      v. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

      vi. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.

      vii. Audible alarm notifications by voice evacuation and tone signals on loudspeakers throughout.

      viii. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers. Facility for total building paging shall be accomplished by the means of an "All Call" switch. Coordinate all paging and zones with owner for programming of building.

      ix. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.

3. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

4. The system shall have the capability of loading software operations from a single node to all other nodes on the network.

5. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

d) Submittals:

1. General: Submit the following according to conditions of contract and Division 26 specification sections.

2. Product Data for System Components: Include dimensioned plans and elevations showing minimum clearances and installed feature and devices. Include list of materials and NRTL-listing data.

3. Submissions to Authority Having Jurisdiction: In addition to routine submissions of the above material, make an identical submission to the authority having jurisdiction. Include copies of annotated contract drawings as required to depict component locations to facilitate review. Upon receipt of comments from the authority, submit them for review. Make resubmissions if required to make clarifications or revisions to obtain approval. Submit all required battery calculations, performance parameters, equipment layout and wiring per recommendations per NFPA 72.

4. The submittal shall also include one set of plans with all devices located on the plans and numbered individually. It shall also include a detailed riser diagram with all devices and wiring requirements indicated on the plans. The fire alarm shop drawings shall not be approved without this submittal.

5. Provide as-built documentation and device address list to owner.

e) Quality Assurance:

1. Installer Qualifications: A factory-authorized installer is to perform the work of this section and shall have NICET certified personnel.

2. Compliance with Local Requirements: Comply with the applicable building code, local ordinances and regulations, and the requirements of the authority having jurisdiction.

3. All work shall be in compliance with applicable sections of NFPA.

4. All items of the fire alarm system shall be listed as a product of a single US manufacturer or division under the appropriate category of UL shall be the UL label.

f) Manufacturers:

1. Base bid shall be Simplex with equals by Firelite, Notifier, Honeywell, Siemens. Request for substitutions shall be in accordance with Section 26.

g) Extra Materials:

1. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

A. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.

B. Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.

C. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.

D. Detector or Sensor Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

h) Products:

1. Fire Alarm Control Panel (FACP):

   A. General: Comply with UL 864, “Control Units for Fire-Protective Signaling Systems.”

   B. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the systems are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of units as well as field wiring. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch high.

   C. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in modules. Construction requiring removal of field wiring for module replacement is not acceptable.

   D. Control Modules: Types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals notify of alarm, supervisory, and trouble conditions.

   E. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 80 characters displays alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.

   F. Instructions: Printed or typewritten instruction card mounted behind a LEXAN plastic or glass cover in a painted steel or aluminum frame. Install the frame in a location observable from the FACP. Include interpretation and appropriate response for displays and signals; and briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

   G. Power panel with 120V input power, sealed, lead acid battery and charging circuits, fused disconnect, auxiliary relay, and all required power supplied for devices and 25% future capacity. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

   H. Addressable Network:

      i. Communication with Addressable Devices: The system must provide communication with initiating and control devices individually. All of these devices will be individually annunciated at the control panel.

      ii. All addressable devices shall have the capability of being disabled or enabled individually.

      iii. A minimum of 10,000 total feet of twisted, shielded 18 AWG wire may be connected to channel. Maximum distance from the panel to the farthest device shall be 2,500 feet.

   I. Historical event logs shall be available from the LCD display or shall be capable of being printed.

   J. Minimum panel capacity shall be 198 addressable devices, with provisions for expansion modules to support existing buildings and future additions.

   K. Remote Annunciator(s) with two line LCD display of alarm, supervisory, and status messages with keypad operation.

i. Provide LCD remote annunciator(s) at entrance or in location as indicated on the plans.

L. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features including amplifiers, dedicated supervised communication lines and emergency voice communication controller with status indicator.

2. Manual Pull Stations:

A. Description: Addressable single- or double-action type, red LEXAN, with flush mounting plate and molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

B. Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

3. Smoke Sensors:

A. General: Comply with UL 268, “Smoke Detectors for Fire Protective Signaling Systems.” Include the following features:

i. Factory Nameplate: Serial number and type identification.

ii. Operating Voltage: 24 VDC, nominal.

iii. Addressability: Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Detectors that store the device address in the head shall be acceptable. Sensors do not require resetting or readjustment after actuation to restore normal operation.

iv. Each sensor twist lock base shall contain an LED that will flash each time it is scanned by the control unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.

v. Each sensor base shall contain a magnetically actuated test switch to provide for an easy alarm testing at the sensor location.

vi. Each sensor shall be scanned by the control unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a “wrong device,” the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5 percent obscuration for photoelectric sensor, 135 deg F and 15 deg F rate-of-rise for heat sensor, but shall indicate a “wrong device” trouble condition.

vii. The sensor’s electronics shall be immune from false alarms caused by EMI and RFI.

viii. Removal of the sensor head for cleaning shall not require the setting of addresses.

B. Photoelectric Smoke Detectors: Include the following features and characteristics:

i. An infrared detector light with matching silicon cell receiver and actuated by the presence of visible products of combustion. Must have seven sensitivity settings and transmit actual values to the FACP.

C. Ionization-Type Smoke Detector: Include the following features and characteristics:

i. Multiple-chamber-type operating on the ionization principle and actuated by the presence of invisible products of combustion.

D. Duct Smoke Detector: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applicable. Required on the return for all units over 2000cfm and supply and return side of all AHU over 15,000 CFM.

i. The addressable duct smoke sensors shall be photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.

ii. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single “Form C” contact rated at 7A at 28 VDC or 120 VAC resistive. This auxiliary relay output shall be fully programmable.

iii. Duct housing shall have a relay control trouble indicator yellow LED, and a magnetic test area and red sensor status LED.

iv. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

v. Each duct detector shall have a remote test station with an alarm LED and test switch located in an accessible location. Coordinate with electrical contractor.

4. Other Detectors:

A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

i. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

ii. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.

iii. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

B. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies and carbon monoxide as indicated. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

C. Carbon monoxide detectors shall be provided by the fire alarm contractor for all rooms with gas-fired equipment, including rooms with water heaters, boilers, etc. and central locations served by first supply grille for each rooftop unit whether specifically shown or not. Carbon Monoxide detectors shall be addressable and powered through the fire alarm system. Carbon monoxide detectors shall be located and installed per the manufacturer’s recommendations.

CO detectors shall comply with UL2034 and NFPA720. Detectors shall provide alarm contacts and trouble contacts, include means for integration to fire alarm system, and test button.

5. Addressable Circuit Interface Modules:

   A. Addressable Circuit Interface Modules: Arrange to monitor one (1) or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems. Provide connection for all devices provided by sprinkler contractor whether indicated on drawings or not.

   B. Addressable circuit interface modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or separate 2-wire pair running from an appropriate power supply as required.

   C. The circuit interface module shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

6. Magnetic Door Holders:

   A. Description units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Units shall operate from a 24 VDC source and develop a minimum of 25 pounds holding force. Finish shall match door hardware.

7. NAC Power Extender:

   A. The Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits. Provide as required.

   B. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.

   C. The NAC extender panel may be mounted close to the host control panel or can be remotely located. The Extender Panel when connected to an addressable panel shall connect to the host panel.

   D. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

8. Alarm Notification Appliances:

   A. Notification Appliances: The Contractor shall furnish and install non-addressable notification appliances and accessories to operate on compatible signaling line circuits (SLC).

   B. Addressable notification appliance operation shall provide power, separate control, and supervision of horns, speakers, and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with

capacitance rate of less than 60 pf/ft and a minimum of three (3) twists per foot.

C. All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows “On the fly” program operation changes for Mass Notification alerting and fire alarm notification.

D. Class B (Style 4) notification appliances shall be wired without requiring in/out wiring methods.

E. Visible/Only (V/O): Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang, or 4-inch square electrical box without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of three (3) twists per foot. V/O appliances shall be provided with different minimum flash intensities of 15, 30, 75 and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific V/O appliance.

F. Appliances shall be wired with UTP conductors, having a minimum of three (3) twists per foot. The appliance shall be capable of 2-wire synchronization to provide synchronized strobe with steady or coded pattern on horn.

G. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker operates on a 25VRMS or 70.7VRMS NAC. All devices mounted on ceiling shall be white.

   i. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.

   ii. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 82 dBA at 10 feet.

   iii. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

   iv. The S/V installs directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.

H. Elevators:

   i. Refer to the contract documents for the elevator fire/smoke control schematic. Provide all necessary control and monitoring modules as indicated for the control and monitoring of all items as noted. The contractor shall provide all wiring as required for connection to each elevator controller. Verify all wiring requirements with the equipment manufacturer.

I. All of the fire sprinkler tamper and flow switches shall be connected to the main fire alarm system. Coordinate exact location and requirements with fire sprinkler contractor. Tamper and flow switches are provided by the fire sprinkler contractor per section 21 of the specifications. The fire alarm contractor shall provide all hardware, software and wiring necessary for connection of all of these switches to the fire alarm system. Coordinate with the fire sprinkler contractor and include all of them in the base bid.

J. Tamper switches, and modules for monitoring high pressure, low pressure and flow are required at all the dry pipe sprinkler compressors in the building. Coordinate all requirements with fire sprinkler contractor and include in the base bid.

K. The tamper switch for each of the fire sprinkler post indicator valves shall be provided by the fire alarm contractor and connected to the building fire alarm system. Coordinate exact location and requirements with fire sprinkler contractor. This and the wiring/conduit required shall be included in the base bid whether specifically indicated on the drawings or not.

L. Provide weatherproof housing for all devices installed at the exterior of the building.

i) Installation – General:

1. Install system according to NFPA standards referenced in Parts 1 and 2 of this section.

2. Fire Alarm Power Supply Disconnect: Shall be painted red and labeled “FIRE ALARM.” Provide with a lockable handle or cover.

3. All wiring shall be in conduit where exposed or where required by NEC or NFPA.

j) Equipment Installation:

1. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

2. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

3. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

k) Wiring Installation:

1. Wiring Method: Install wiring in metal raceway according to this specification and per NEC and NFPA. Conceal raceway except in unfinished spaces as indicated.

2. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

3. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

4. Provide all ethernet connections to panel. The electrical contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control panel and other designated equipment locations prior to system turnover.

l) Grounding:

1. Ground equipment and conductor and cable shields as specified by the equipment manufacturer. For audio circuits minimize to the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5 ohm ground at main equipment location. Measure, record, and report ground resistance.

m) Field Quality Control:

1. Manufacturer’s Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

2. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the drawings and specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

3. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

4. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

5. Minimum Systems Tests: Test the systems according to the procedures outlined in NFPA 72.

6. Retesting: Correct deficiencies indicated by tests and complete retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.

7. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.

8. Tag all equipment, stations, and other components at which tests have been satisfactorily completed. Final test, certificate of completion, and certificate of occupancy.

9. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Demonstrate that the system meets the specifications and complies with applicable standards. This final test shall be witnessed by a representative of the Authority Having Jurisdiction and a factory authorized service representative.

n) Cleaning and Adjusting:

1. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

2. Occupancy Adjustments: When requested within one-year of date of substantial completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three (3) visits to the site for this purpose.

o) Training:

1. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

2. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours training.

3. Schedule training with the Owner at least seven days in advance.

26-56 EMERGENCY INVERTER SYSTEM (UPS SYSTEM):

a) General:

1. The UPS shall provide high quality, computer grade AC power for today's electronic lighting loads (power factor corrected and self-ballast fluorescent, incandescent, quartz re-strike, halogen, LED and HID) during emergency backup. Requirements of the following Division 26 sections apply to this section.

2. The UPS shall incorporate a high frequency pulse width modulated (PWM) sine wave inverter utilizing IGBT technology, a microprocessor controlled inverter and a temperature compensating battery charger, communication port, and a user friendly control panel with audible and visual alarms.

3. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall supersede.

   A. UL 924 Standard Emergency Lighting and Power Equipment

   B. UL 924A Auxiliary Lighting

   C. ANSI C62.41 (IEEE 587)

   D. ANSI C62.42.45 (Cat. A & B)

   E. National Electrical Code

   F. NFPA- 101 (Life Safety Code)

   G. OSHA

b) Equipment Description:

1. The basis of design shall be Myers model number 1-EM-4-S-BA2002. **Alternate equivalent equipment may only be provided with approval from D/E prior to bid. Equipment from equivalent manufacturers must submit data sheets for review by D/E prior to approval. Equipment with equivalent kVA ratings from other manufacturers may not be sufficient to meet the load demand.**

2. The input and output voltages shall be 120VAC, 1ph, 2W plus ground.

3. The output load capacity of the UPS shall be 2.8 kVA. The UPS shall be able to supply rated kW from 0.5 lagging to 0.5 leading power factor.

4. Battery System:

   A. The UPS shall be provided with sealed, valve regulated, lead acid batteries.

   B. The battery shall be sized to power the loads shown on the drawings for a total of 120 minutes minimum.

   C. The battery charger shall recharge the fully discharged batteries within a 24-hour period. The charger shall be an integrated 3-step, microprocessor controlled and temperature compensating.

5. Circuit breakers:

   A. Equipment shall be provided with (2) 20A, 1ph factory installed circuit breakers.

6. The UPS shall be designed to operate with less than a 2-millisecond transfer time:

   A. Normal: The UPS Inverter is a line interactive standby system and the commercial AC power continuously supplies the critical load. The input converter (bi-directional transformer) derives power from the commercial AC power source and supplies to the inverter while simultaneously providing floating charge to the batteries.

B. Emergency: Upon failure of the commercial AC power the inverter instantaneously with a maximum of a 2-millisecond break, switches its power supply from the input converter to the battery system. There shall be no loss of power to the critical load upon the failure or restoration of the utility source.

C. Recharge: Upon restoration of commercial AC power after a power outage, the input converter shall automatically restart and start charging the batteries. The critical loads are powered by the commercial AC power again.

c) Performance Requirements:

1. AC Input to UPS

A. Voltage Configuration for Standard Units: 1-phase, 2-wire-plus-ground.

B. Voltage Range: (+10%, -10%)

C. Frequency: 60 Hz (+/- 3%)

D. Power Factor: . 5 lagging / leading

E. Inrush Current: 1.25 times nominal input current, 10 times 1 line cycle for incandescent loads

F. Current Limit: 125% of nominal input current

G. Current Distortion: 10% THD maximum from 50% to full load

H. Surge Protection: Sustains input surges without damage per standards set in UL924

2. AC Output, UPS Inverter

A. Voltage Configuration for Standard Units: 1-phase, 2-wire-plus-ground

B. Static Voltage Stability: Load current changes +/- 2%, battery discharge +/- 12.5%

C. Dynamic Voltage Stability: +/- 2% (25% step load), +/- 3% (50% step load)

D. Dynamic Recovery Time to within 1% of nominal: 3 cycles (0-100% load step)

E. Output Harmonic Distortion: < 3% (with linear load)

F. Frequency: 60 Hz (+/- .05Hz during emergency mode)

G. Load Power Factor Range: 0.5 lagging to 0.5 leading

H. Output Power Rating: kVA = kW

I. Overload Capability: to 100% continuous rating
to 115% for 10 minutes
to 150% for 16 line cycles

J. Crest Factor: <= 4.5

K. Efficiency 97 - 98%

d) Alarms, Monitoring, and Control:

1. The charger is equipped with a DC over-voltage protection circuit so that if the DC voltage rises above the pre-set limit, the charger shuts down automatically and initiates an alarm condition.

2. The UPS system provides operation monitoring and control, audible alarms, and diagnostics. The front-mounted control panel includes a 4-line by 20-character vacuum fluorescent display and a keypad for user interface. The display will be menu driven. The system will have a continuous scrolling display of the following: Date & time, System Status (AC Status, Battery Status, Charger Status) and any system faults: This allows the operator to easily "watch" system functions as they occur and check on virtually any aspect of the system's operation. Monitoring and control are microprocessor-based for accuracy and reliability. To ensure only authorized personnel can operate the unit, the system is multi-level password protected for all control functions and parameter changes.

3. Scrolling through the meter functions can monitor the following measurements:
   - Utility input voltage
   - System output voltage
   - Battery voltage
   - Battery current
   - System output current
   - System output VA
   - Inverter wattage
   - System temperature
   - Date & time
   - System Days

4. An audible and visual alarm activates when an output distribution circuit breaker is open or has tripped.

5. The email/fax/voice modem option can be configured to send a system status report via any combination of email, fax, or voice message upon completion of a preprogrammed monthly or yearly test and upon any customer selected alarm condition. Meets NFPA requirements. Bi-directional communications allows system diagnostics and data retrieval through the RS-232 serial communications port.

6. Form "C" contacts rated at 5 amps maximum at 250VAC/30VDC. Dry contacts will change state when any system alarm activates. Contacts change states with the following alarms: High battery charger fault, near low battery, low battery, load reduction fault, output overload, high/low AC input volts, high ambient temperature, inverter fault, and with optional circuit breaker trip alarm.

7. This device is internally mounted in the system and permits maintenance personnel to easily bypass the protected equipment directly to the AC utility power. The make before break switch isolates the system to perform routine maintenance or servicing.

8. Form "C" dry contacts capable of monitoring system and option statuses (Inverter On, Inverter Off, AC Present, High Temperature, Summary Alarm.)

e) The proposal submittals shall include the following:

1. System configuration with single line diagram.

2. Functional relationship of equipment including weights dimensions and heat dissipation.

3. Descriptions of equipment to be furnished, including deviations from these specifications.

4. Size and weight of units to be handled by installing contractor.

5. Data sheets showing relationship of the load (including inrush currents) to the rated kVA of the

equipment to be provided.

f) The delivery submittals shall include the following:

1. A complete set of submittal drawings.

2. One set of instruction manuals. Manuals shall include a functional description of the equipment, installation, safety precautions, instructions, step-by-step operating procedures, and routine maintenance guidelines, including illustrations.

g) Installation:

1. All wiring shall be installed in conduit. Input and output wiring shall enter the cabinet in separate conduits.

2. All wiring and installation shall comply with other portions of the Division 26 specifications and all relevant codes and standards.

3. Site start-up and testing shall be provided by the manufacturer's field service representative during normal working hours (Mon. - Fri. 8 a.m. - 5 p.m.). Individual scheduling requirements can usually be met with 7 working days advance notice. Site testing shall consist of a complete test of the UPS and accessories by the UPS manufacturer in accordance with manufacturer's standards. Manufacturer's approved service representative must perform commissioning for two-year warranty to apply.

h) Warranty:

1. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever occurs first. The standard warranty will be increased to 2 years with the purchase of a factory start-up.

2. The battery manufacturer's standard warranty shall be passed through to the end user.

3. Sealed Lead Calcium VRLA, 10-year life expectancy – one-year full replacement warranty plus an additional nine years pro-rata.

i) Testing:

1. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

26-57 PLENUM CABLE FIRE RATED PATHWAY DEVICE:

a) General:

1. Furnish and install EZ-Path fire rated wiring devices and associated hardware as shown on the Contract Drawings or as required in all corridor/hallway fire rated walls and as hereinafter specified as manufactured by Specified Technologies, Inc. or equal. All devices shall be UL listed and tested in accordance with ASTME814. Equivalent by Wiremold Flamestopper or by prior approval only.

2. All devices shall be heavy-duty specification grade with an intumescent insert material allowing for 0 to 100-percent visual fill of conductors.

b) Wiring devices:

1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.

2. The device shall have an F Rating equal to the rating of the barrier in which the device is installed.

3. Wiring devices shall be capable of allowing a 0 to 100-percent visual fill of cables.

4. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.

5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

c) Installation:

1. Wiring devices shall be installed in locations as required on the Contract Drawings, arranged singly or in gangs at the height specified.

2. Install the devices in strict accordance with the approved shop drawings and the equipment manufacturer's recommendations.

3. Apply the factory supplied gasketing material prior to the installation of the wall plates.

4. Secure wall plates to devices per the equipment manufacturer's recommendations.

26-58 COMBINATION MAGNETIC MOTOR STARTERS:

a) Provide 600 volt, 60 hertz AC across-the-line fusible magnetic type rated in accordance with NEMA standards and listed and labeled in accordance with UL 508.

b) Starter NEMA enclosure type shall be required for starter location and environment.

c) Disconnect switch and magnetic starter shall meet requirements of Articles SAFETY SWITCHES in specification.

d) Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.

e) Starter shall have permanently affixed to inside of enclosure cover in easy to read wiring diagram including alternate control variations and also a warning sign indicating maximum current limiting fuses size that may be in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.

f) Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.

g) Provide starter with melting alloy type overload relays on all phases. Bi-metallic type overload relays will not be approved. Overload thermal unit shall be one piece interchangeable construction non-adjustable. Starter shall be inoperative with thermal unit removed. Starters shall not be furnished to E/C with jumper straps in overload units.

h) Thermal units' ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by 0.90 for motors with 1.0 service factor and by 0.95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturers' overload selection tables.

i) Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with Fusetron Dual Element Fuses in transformer primary. Where starters are noted to be controlled by another control system (including, but not limited to temperature controls, fire alarm, boiler controls, kitchen hood controls, etc.), it shall be the E/C's responsibility to coordinate required control voltage with associated system prior to ordering starter and order appropriate accessories to allow proper control and function.

j) Starter shall be suitable for additional of at least four electrical interlocks of any arrangement of normally open or closed contacts.

k) Provide starter with accessories such as auxiliary contacts, pilot lights, start-stop, or HOA switches as required to obtain control sequence shown on drawings or specified. Accessories shall be available as kit for field installation or modification.

l) Soft start shall be Square D Altistart or equivalent.

m) Provide combination starter by Allen-Bradley, Eaton/Cutler-Hammer, ITE/Siemens, or Square D.

n) See schedule.

26-59 VIDEO INTERCOM SYSTEM

a) Provide Aiphone JP series video intercom system. **T**he JP Series shall provide a large 7-inch (180 mm) touch screen monitor for clear visitor identification and easy operation control. The JP Series shall be installed at a maximum of 4 door locations and connected to a maximum of 8 inside locations with internal communication between stations. Connection to and integration of CCTV cameras for surveillance capabilities shall be available.

1. The system shall be hard wired and constructed with a 2-wire communication system for the door stations and a Cat5e/6 communication system for the video locations system.

2. Hearing Assistance: Provide T-Coil connection for hearing aids.

b) Functional Components: As indicated on the drawings or as required to complete system.

1. Master Station.

   A. JP-4MED: Hands-free/Handset color video intercom master station.

2. Video Door Station:

   A. JP-DVF: PanTilt & Zoom vandal-resistant video door station, flush mount.

3. Door Station:

   A. GT-D: Audio only door station.

4. Distribution Adaptor:

   A. JP-8Z: Distribution adaptor.

5. Power Supply:

   A. PS-2420UL: 24V DC Power supply.

6. Call Extension Speaker:

   A. IER-2: Call extension speaker.

7. External Devices:

   A. RY-3DL: Multiple door release adaptor.

c) System Design: Unless noted otherwise on drawings provide system layout as follows. Three wiring methods are possible; Station-to-Station, Centralized Wiring, or Combined Wiring, where both methods are employed in the same system.

1. Provide Station-to-Station Wiring: Directly connect a master station to a sub master station.

   A. Maximum distance of farthest sub master from master station: 980 feet (300 m), cumulative.

   B. Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m)

when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.

2. Provide Centralized Wiring: Connect master stations, and sub master stations to a central wiring adaptor.

   A. Maximum distance of farthest sub master from distribution adapter (JP-8Z): 165 feet (50 m).

   B. Maximum distance of master from distribution adapter (JP-8Z): 650 feet (200 m).

   C. Maximum cumulative distance of master and sub masters from distribution adapter (JP-8Z): 980 feet (300m).

3. Provide Combined Wiring: Connect a system using both station-to-station and centralized wiring to meet the requirements of the project.

   A. Maximum distance between sub master stations in station-to-station wiring: 98 feet (30 m) when 3 stations are powered off 1 power supply, or 165 feet (50 m) when 2 stations powered off of 1 power supply.

   B. Maximum distance of sub masters from distribution adapter (JP-8Z): 165 feet (50 m).

4. Provide Expanded Performance:

   A. The wiring distance between the door and master stations by using the JPW-BA adaptor shall be a maximum distance of 980 feet (300 m).

   B. Connect CCTV and Audio Door Station: Provide security camera connection using the JPW-BA adaptor. Provide for two way communication as indicated or scheduled with a GT-D audio device.

   C. Alarm Inputs: The master station and all sub master stations shall send out an alarm notification when the sensor is triggered. Provide door/window contacts, water sensors, and PERS devices as indicated or scheduled.

d) Submittals

1. Submit under provisions of Section 01 30 00 - Administrative Requirements.

2. Product Data: Manufacturer's data sheets on each product to be used, including:

   A. Preparation instructions and recommendations.

   B. Storage and handling requirements and recommendations.

   C. Installation methods.

3. Shop Drawings: Submit the following:

   A. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.

   B. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

4. Installation and Operation Manuals:

   A. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.

   B. Provide detailed information required for Owner to properly operate equipment.

5. Warranty: Submit manufacturer's standard warranty.

6. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

7. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

e) Quality Assurance

1. Manufacturer Qualifications: ISO 9001:2008 certified company.

2. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

3. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

   A. Finish areas designated by Architect.

   B. Do not proceed with remaining work until workmanship is approved by Architect.

   C. Refinish mock-up area as required to produce acceptable work.

f) Delivery, Storage, and Handling

1. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

2. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

3. Handling: Protect materials during handling and installation to prevent damage.

g) Project Conditions

1. 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.

h) System shall be by Aiphone only.

i) Hands Free/Handset Color Video Intercom System

1. Color Video Intercom System: JP Series Intercom System as manufactured by Aiphone Corporation.

2. Room Master Station: JP-4MED 7 inches (180 mm) Digital PTZ Video Master Station with Memory.

   A. The JP Series shall accommodate up to 4 Door Stations and 8 Master Stations in a single system.

   B. Provide icon driven One Touch Hands Free operation. Touch the screen to communicate with visitors using the built-in microphone and speaker or use the handset at any time during conversation for privacy.

   C. Operation: From Master Station. Provide the following.

      i. Room Call: Touch screen icon to call a single sub master station or all sub master stations simultaneously.

ii. Play: Touch screen icon to play recorded images from door stations.

iii. Settings: Touch screen icon to program settings and adjustments.

iv. Security: Touch screen icon to activate the security mode or to change security settings.

v. Monitor: Touch screen icon to monitor a door station or sub master station.

vi. Option: Touch screen icon to activate the connected external device(s).

D. Available Functions During Monitoring: Provide the following.

i. Pan-Tilt-Zoom/Wide camera control.

ii. When monitoring is started, an image shall be shown in wide mode. Pan & Tilt and adjusting images shall be possible from the Master Station.

iii. Door release shall be possible from the Master Station.

iv. Volume control shall be possible from the Master Station.

v. Manual recording shall be possible from the Master Station.

vi. If a CCTV camera is connected instead of a video door station at entrance, provide audio monitoring and communication via the GT-D.

E. Physical Characteristics:

i. Power supply: DC 24V (from power supply).

ii. Communication: Handset - Simultaneous communication.

iii. Communication: Hands-free - Auto-voice actuation.

iv. Monitor: 7 inches (180 mm) color LCD monitor.

v. Mounting: Wall mount.

vi. Electrical box: 3-gang box

vii. Material: Flame resistant ABS resin.

3. Power Supply: PS-2420UL, 24V DC Power supply.

4. Call Extension Speaker: IER-2, Call extension speaker

5. External Devices:

A. RY-3DL: Multiple (3) door release adaptor.

6. Long Distance Adaptor: JPW-BA.

A. Power Supply: DC 24V (from power supply)

B. Current Consumption: 90 mA

C. Mounting: Wall-mount

7. Distribution Adaptor: JP-8Z.

A. Power Supply: DC 24V (from power supply)

B. Current Consumption: 90 mA

C. Mounting: Wall-mount.

j) Execution

1. Examination

A. Examine areas to receive integrated security and communication system.

B. Notify Architect of conditions that would adversely affect installation or subsequent use.

C. Do not begin installation until unacceptable conditions are corrected.

2. Preparation

A. Verify the following compliance before starting installation.

i. All units, except for the entrance station and tenant door station, are designed for indoor use only. Do not use outdoors.

ii. The unit turns inoperative during power failure.

iii. In areas where broadcasting station antennas are close by, intercom system may be affected by radio frequency interference.

iv. Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.

v. Keep the unit more than 3.3 feet (1 m) away from radio or TV set.

vi. If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.

vii. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.

viii. The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3. Installation

A. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.

B. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

4. Setup and Adjusting

A. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

5. Demonstration and Training

A. Demonstration:

i. Demonstrate that integrated security and communication system functions properly.

ii. Perform demonstration at final system inspection by qualified representative of manufacturer.

B. Instruction and Training:

i. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.

ii. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.

iii. Provide instruction and training by qualified representative of manufacturer.

6. Protection

A. Protect installed integrated security and communication system from damage during construction.

END OF DIVISION 26

DIVISION 27 – COMMUNICATIONS – BUILDING PACKAGE

27-1 CONTRACT DOCUMENTS:

a) All contract documents including drawings, alternates, addenda, and modifications preceding this Specification Division are applicable to Electrical Contractor and Communications contractor and additional subcontractors and material suppliers.

27-2 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) When a word such as “proper,” “satisfactory,” “equivalent,” and “as directed” is used, it requires Engineer’s review.

c) “Provide” means furnish and install.

d) “Working Day” wherever used in these Specifications, shall mean the normal working days Monday through Friday, exclusive of Saturday, Sunday, and federally observed holidays.

e) Architect/Engineer hereinafter abbreviated A/E shall mean both the Design Architects and the Design Engineers.

f) Design Engineer Design Engineer hereinafter abbreviated D/E shall mean the engineering firm, RTM Engineering Consultants., 3333 E. Battlefield Suite 1000 Springfield, MO 65804, Telephone (417) 881-0020. Contact Person: Tyler Enserro

g) General Contractor hereinafter abbreviated G/C shall mean the person or company and their subcontractors who enter into contract with the Owner to perform the general division work.

h) Electrical Contractor hereinafter abbreviated E/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the electrical division work.

i) Mechanical Contractor hereinafter abbreviated M/C shall mean the person or company and their subcontractors who enter into contract with the G/C to perform the mechanical division work.

j) Equipment and/or materials manufacturer hereinafter abbreviated E/M shall mean the manufacturer of equipment or materials specified or referred to.

k) For purposes of clarity, the following systems will be covered under this section:

1. Telephone/Data Cabling System
2. CCTV Camera/Secure Access Control system (by vendor direct to owner, NetWatch)
3. Audio Visual Systems by Owner (not included)
4. Wireless Access Points - equipment furnished by Owner, installed by contractor
5. HDMI connections from wall equipment to jacks

27-3 SUMMARY OF WORK:

a) Cabling:

1. Contractor shall provide all copper and fiber backbone and horizontal cabling and all termination devices and equipment at each end including data devices, televisions, projectors, and cameras. Owner shall provide wireless access points and central equipment. Contractor shall provide and install jacks, terminations and connectors for complete and operational system for all data devices. Wireless access points along with cable and jacks shall be installed by contractor.

2. This document specifies the owner's requirements for product design, performance, quality assurance, and contractor responsibilities for execution of work to install a complete CATEGORY 6 structured cabling system in a fully exposed ceiling environment. Execution of work includes delivery and storage of materials, preparation, installation, field-testing, and project completion tasks. System certification and warranty submittal requirements for completed work and future moves, adds and changes (MAC's) are also specified in this document. Compliance to applicable codes, standards and regulations is required for all construction work performed.

3. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities for all cabling products shall be provided as required to complete cabling to all work stations as shown on floor plans.

4. The Approved Contractor shall furnish the required materials and labor to complete the CATEGORY 6 cabling infrastructure specified in the contract documents. Construction work shall comply with contract drawings, specifications, project completion schedules, and applicable codes and standards.

5. Work shall include all detailed execution requirements, such as preparation, installation, system certification, and project closeout activities according to the contract. The same manufacturer's product shall be utilized throughout the entire project for all copper and fiber optic cabling and connectivity. Substitutions: No substituted products shall be installed except with written approval by Owner or as specifically noted.

b) Audio Visual Systems:
   1. Contractor shall provide A/V drops as shown on contract drawings. Any required HDMI cable and associated jacks shall be contractor furnished and installed. E/C shall provide all rough-in and blank coverplates as required.

c) Security, Access Control and CCTV:

   1. Owner's vendor, NetWatch shall provide cameras including devices, components, central equipment and programming as required.

   2. Contractor shall include provide complete conduit system, required rough-in for all equipment, and CAT6 for all locations in the building. Rough-in shall not be required for equipment installed on lay-in ceiling. Provide one CAT6 cable for each card reader and camera location on the plans.

d) Approved Communication Contractors shall:

   1. The contractor shall have experience in the installation and testing of similar systems as specified herein and shall have completed at least two projects of similar size and scope within the last 24 months. The contractor shall provide references upon request (including the project name, address, date of implementation, client name, title, telephone number, and project description.

   2. All members of the installation team must be certified by the manufacturer as having completed the necessary training to complete their part of the installation. All personnel shall be adequately trained in the used of such tools and equipment as required.

   3. At least 1 level 2 BICSI installer onsite during work.

   4. At least 1 BICSI RCCD on staff.

5. The contractor bidding on communication systems specified herein shall be certified by the connectivity manufacturer to install, service, and warranty the specified product prior to the time of bid and throughout the duration of the installation. Manufacturer certifications shall not be project specific and should be valid for any and all projects completed by contractor.

6. The contractor shall own and maintain tools, installation equipment, and test equipment necessary for successful installation and testing of optical and category 5e, 6 & 6 premise distribution systems.

7. The owner reserves the right to require the contractor to remove from the project any such employee the owner deems to be incompetent, careless or insubordinate.

8. The contractor shall have primary place of business, official office not a residential dwelling, located no more than 100 miles from the job site.

9. The contractor must maintain a state contractor's license as required by the state.

10. The contractor shall provide copies of certificates for proof of manufacturer's training, manufacturer's certified installer, authorized distributor in the shop drawing submittal and at the request of the engineer to verify compliance with specification prior to recommendations for awarding bid.

11. The contractor installing the structured cabling shall have a RCDD on staff and consulting on the project. There shall be at least one level 2 BICSI installer on site during the project. The contractor's RCDD/project manager shall complete at a minimum the following tasks.

    a. Review and submit contractor's changes to original shop drawings.

    b. Review and sign completed punchlist items.

    c. Review and submit contractor's as-built documentation.

12. The approved contractor shall assume the following responsibilities:

    a. Execute construction in accordance with contract drawings and specifications.

    b. Adhere to project schedules and job site rules.

    c. Adhere to the quality, regulatory, logistics, and documentation requirements.

    d. Furnish the cabling system certification and warranty provisions as noted.

    e. Adhere to the product requirements and execution guidelines outlined above and within construction documents.

27-4 GENERAL EXTENT OF WORK:

a) Provide systems, labor, materials, tools, equipment and services indicated on drawings, specified or reasonably implied. Provide every device and accessory for proper operation and completion of all systems. In no case will claims for "Extra Work" be allowed for work about which contractor could have informed himself before bids were taken.

b) Contractor shall familiarize himself with equipment provided by other contractors, which require electrical connections and controls. All work shall comply with Division 26.

c) Contractor shall be responsible for compliance with all owner installation and specification items included at the end of this specification section.

d) Provide all labor, and supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.

1. Provide any floor penetrations, floor sleeves, conduit raceways, wall penetrations, etc. not shown on the electrical plans but needed for the routing of cabling provided herein if requested.
2. Provide EZPath firestopping at the IT Equipment room and other locations as required.
3. Provide labor for testing horizontal and backbone cabling.
4. Provide labor for Wireless LAN Access Point, Antennas and Power Injector installation and system testing.
5. Provide Telecommunications grounding and bonding.
6. Conduit floor sleeves, conduit and supports required for installation of all cabling if requested.

e) Provide complete installation for Structured Telecommunications Cabling System including but not limited to:

1. CATEGORY 6 UTP horizontal cables.
2. Single mode optical fiber backbone cables.
3. Termination at patch panels and testing
4. Work area telecommunication outlets.
5. Wall mounted outlets.

f) The owner shall provide and install the following:

7. CATEGORY 6 modular patch panels.
8. Optical fiber patch panels.
9. Switches and UPS
10. Data and Voice CATEGORY 6 patch cords
11. Optical fiber patch cords.
12. Wire management panels and racks

27-5 COMMON WORK REQUIREMENTS:

a) General: All work shall comply with the general construction, installation, and general building requirements in Specification 26.

b) All A/V wiring for HDMI connections to televisions, shall be provided and installed by contractor. Provide all CAT6 for computers, printers, copiers, phones, wireless access points, digital signage, televisions, and projectors.

c) Owner shall provide phones, network cards, expansion racks, software, programming, etc. as required for complete and operational phone system.

d) This communication contractor shall include all required phone and data connections for fire alarm panels, DDC control system, lighting control system, and security system.

e) The contractor shall install fiber to existing main panel at Hubbel and coordinate termination and service testing for the new building with owner and designated personal. Provide the fiber service feeds into building to the main IT room and equipment.

f) All components and wiring shall be installed in accordance with BICSI installation guidelines and per all owner requirements. Contractor shall be responsible to ensure cable distances are limited as required and coordinated routing with building conditions and equipment by other trades.

g) Provide shop drawings per other specifications and project requirements. At a minimum, include complete system shop drawings including equipment spec sheets, wiring diagrams, equipment rack layouts, labeling schemes, cable distances, certifications for technicians and project manager, test plan, warranty and certification, and proposed test equipment certificates.

27-6 COMMUNICATIONS EQUIPMENT ROOM EQUIPMENT:

a) Coordination:

1. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

   A. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

   B. Record agreements reached in meetings and distribute them to other participants.

   C. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

b) Products:

1. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

   A. Support brackets with cable tie slots for fastening cable ties to brackets.

   B. Lacing bars, spools, J-hooks, and D-rings.

   C. Straps and other devices.

2. Cable Trays, junction boxes, conduit and other common utility supports under Division 26.

c) Backboards:

1. Backboards: Plywood, fire-retardant treated, painted, B-C exterior grade 5, 0.75”, from 2’ AFF to 6’ AFF on two walls per owner’s direction. Verify location prior to installation.

d) Racks – Owner furnished and installed.

e) Cable management – Owner furnished and installed.

f) Grounding:

1. Comply with requirements in Division 26 Section "Grounding" for grounding conductors and connectors.

2. Telecommunications Main Bus Bar:

   A. Connectors: Mechanical type, cast silicon bronze, solderless type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

   B. Ground Bus Bar: Copper, minimum 0.25-inch-thick by 4 inches wide with 0.28125-inch holes spaced 1.125 inches apart.

   C. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

3. Comply with ANSI and EIA/TIA 607.

g) Labeling:

1. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

h) Entrance Facilities:

1. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

2. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

3. Install underground entrance pathway complying with Division 26.

i) Installation:

1. Comply with NECA 1.

2. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

3. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

j) Grounding:

1. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

2. Comply with ANSI-J-STD-607-A.

3. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

4. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

27-7 TELECOMMUNICATIONS SYSTEM HORIZONTAL CABLING:

a) General:

1. Performance Requirements:

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.2, when tested according to test procedures of this standard.

b) Quality Assurance:

1. 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.

2. Flame-Spread Index: 25 or less.

3. Smoke-Developed Index: 50 or less.

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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

C. Grounding: Comply with ANSI-J-STD-607-A.

c) General Installation Requirements:

1. All cabling shall be plenum rated and shall be installed in manner as designated by BICSI installation guidelines. All cables shall be supported by cable tray or contractor supplied j-hooks. Wiring installed through structural elements will NOT be approved without written owner or A/E approval prior to installation.

2. Install cables in raceways and cable trays except within consoles cabinets desks and counters. Conceal all raceways except where noted on plans or where noted by A/E.

3. Provide 2 cables/jacks at each rough-in location unless noted otherwise.

4. Terminate all conductors; no cable shall contain unterminated elements.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30” and not more than 6” from cabinets, boxes, fittings, outlets, racks, frames and terminals.

6. Utilize lacing bars to restrain cables where furnished within racks.

d) Products:

1. Pathways:

A. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

i. Support brackets with cable tie slots for fastening cable ties to brackets.

ii. Lacing bars, spools, J-hooks, and D-rings.

iii. Straps and other devices.

2. Category 6 Cabling:

A. Manufacturers: Hubbell Premise Wiring. Product substitutions shall be by written request 20 days prior to bid opening.

B. Description: Hubbell C6SP or C6SR, Category 6, 4 twisted pair UTP, 23 AWG insulated solid conductors, plenum rated covered with a thermoplastic jacket. All cable shall have color by pair, Pair 1 Blue (white/blue), Pair 2 Orange (white/orange), Pair 3 Green (White/Green), Pair 4 Brown (White/Brown).

i. Comply with ICEA S-90-661 for mechanical properties.

ii. Comply with TIA/EIA-568-C.1 for performance specifications.

iii. Comply with TIA/EIA-568-C.2, Category 6.

iv. All cable shall be plenum rated and runs shall not exceed 275’.

3. All cables at each shall be labeled and have 10’ service loop at each end unless noted otherwise on construction documents.

4. UTP Cable Hardware:

   A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

   B. Connecting Blocks: Category 6. Integral with connector bodies, including plugs and jacks where indicated.

   C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

   D. Number of Terminals per Field: One for each conductor in assigned cables.

   E. Jacks and Jack Assemblies: Hubbell HXJ6, Color-coded, eight position modular RJ45 unkeyed, FCC compliant receptacle units designed for 4-pair 100OHM unshielded cable with integral IDC-type terminals. Jacks shall exceed 4 gbit/s data transmission capacity within bandwidth of 1-250mHz when configured in a 4-connector channel. All jacks coverplates shall be labeled with typed room and termination port in manner to match electrical receptacles. Jacks shall accept snap-on icons for identification. Jack color shall be Black for office stations, White for access points, Yellow for CCTV and access control, and RED for server.

   F. Coiled Cables: Cables are specified to be coiled (10’) above ceiling and not terminated in a jack, ends shall be terminated with RJ-45 termination per EIA/Tia 568-B.

   G. Faceplate shall be Hubbell IFP series. Provide faceplates to match electrical devices suitable for installation of all termination devices. Faceplates shall be rear loading window, fit CAT6 modular jack or snap fit multimedia devices, and provided with ANSI/TIA/EIA-606-A compliant workstation outlet labeling.

5. Patch Cords: Owner furnished and installed.

6. Patch panels – Owner furnished and installed.

7. Testing:

   A. After termination of each cable from outlet to patch panel, each cable shall be tested to show compliance with TIA/EIA-568-B-2. Each item tested shall fall within performance thresholds of Category 6 rating.

   B. Provide written reports for each data outlet indicating tests have passed Category 6 rating. Testing and certification shall be returned to owners networking department upon completion of project. Comply with 25 year warranty requirements and all aspects for that warranty for equipment and workmanship and as noted in other areas of the specification. Contractor shall submit signed warranty registration and certificate to owner prior to job completion and final payment.

8. Wiring Methods:

   C. Wiring Method: Install cables in raceways, J-hooks and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces. Cables installed in gypsum board partition shall require individual approval by A/E.

i. Install plenum cable in environmental air spaces, including plenum ceilings.

ii. Provide 10’ slack at jack end of cable coiled above ceiling unless noted otherwise.

iii. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

D. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

9. Installation of Cables:

A. Comply with NECA 1.

B. General Requirements for Cabling:

i. Comply with TIA/EIA-568-B.1.

ii. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

iii. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

iv. Cables may not be spliced. 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.

v. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

vi. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.

vii. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

viii. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

ix. In the communications equipment room, install a 10-foot-long service loop on end of each cable.

x. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

i. Comply with TIA/EIA-568-B.2.

ii. Do not untwist UTP cables more than 0.5 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

i. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

ii. Suspend cable not in a wireway or pathway a minimum of 8 inches above ceilings or at structure where there is not an accessible ceiling by cable supports not more than 60 inches apart.

E. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. All cables shall be supported by communication contractor supplied j-hooks. Wiring installed through structural elements will NOT be approved without written owner or A/E approval prior to installation due to certain existing conditions.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

i. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

ii. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

iii. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

iv. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

v. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2.5 inches.

vi. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

vii. Electrical Equipment Rating Less Than 2 kVA: No requirement.

viii. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

ix. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

10. Identification:

A. Contractor shall verify identification requirements with owner and shall comply with all labeling and identification requirements.

B. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

D. 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.

E. Cable and Wire Identification:

i. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

ii. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A with flexible vinyl or polyester that flex as cables are bent. Labels shall be outwardly facing and consistently applied. 3/8-inch lettering would be idea for cable labels. Wall plate location labeling should be of sufficient size to be readable from 10-feet. All cables both ends and jacks shall be clearly labeled.

27-8 TELECOMMUNICATIONS SYSTEM BACKBONE CABLING:

a) General:

1. Backbone Cabling Description:

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, between racks, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

2. Performance Requirements:

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

b) Products:

1. Pathways:

A. Cable Support: NRTL labeled for support of cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

i. Support brackets with cable tie slots for fastening cable ties to brackets.

ii. Lacing bars, spools, J-hooks, and D-rings.

iii. Straps and other devices.

2. Optical Fiber Cable:

A. Approved manufacturers shall be Hubbell. Reference above sections for alternative requirements.

B. Provide optical fiber optic as follows:

i. Hubbell HFC1 or HFC2 as applicable. Fiber shall be 50/125 micrometer, Class 1A, 24 fiber, 900iM tight buffer, single mode optical laser optimized fiber cable,

OM3 or OM4. Loose tube OSP fiber, Hubbell HFC3, shall be used for applications outside the building and provided with polyethylene jackets and UV protection and provided with breakout kits for termination.

ii. Comply with TIA/EIA-568-B-3 for performance specifications.

iii. Cable shall be plenum rated, non-conductive type OFNP complying with NFPA 262. OM3 for lengths less than 300M and OM4 for lengths less than 500M.

iv. Maximum attenuation shall be 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

v. Minimum modal bandwidth shall be 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

vi. Jacket color shall be yellow and shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches. All fiber shall be rated for location installed.

vii. All fiber shall be installed in innerduct or conduit. When installed outside, a tracer wire shall be installed above conduit. Innerduct shall be by Premier Conduit and shall be 1" and pre-threaded with pull line internal to the building. Provide 4" SDR-11, 3-cell OSP innerduct for all exterior building fiber conduit runs.

C. Fiber optic patch cords: Owner furnished and installed.

3. Optical Fiber Cable Hardware:

A. Hardware shall comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, TIA/EIA-604-12 and TIA/EIA-568-C.3

B. Simplex and Duplex connectors shall be quick connect type with insertion loss not more than 0.75 dB.

C. Hubbell SFFLCW, SC Duplex flush mount keystone adapter factory loaded with LC MM simplex adapters or Hubbell SFFSCW with SC MM simplex adapter. All faceplates shall match CAT6 plate requirements.

D. Hubbell Proclick FCSC900K50GM or Hubbell Proclick FCLC900K50GM optical fiber optic connectors. Prepolished fiber connector shall be factory prepolished SC or LC style optical fiber connector with a zirconium ceramic ferrule. Housing of connector will be aqua to signify OM3 or OM4.

E. Fiber Patch Panels: Owner furnished and installed.

F. Testing:

i. Fiber optic cables shall be tested to show compliance with TIA/EIA-568-B-1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel link or link test configuration.

ii. Link End-to-End Attenuation tests shall be as follows:

(a). Horizontal and multimode backbone link measurements: Test at 850 nm or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, one reference jumper.

(b). Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA 568-C-3.

G. Provide written reports showing test compliance with applicable standards

H. Pathway Installation in Communications Equipment Rooms:

i. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

ii. Secure conduits to backboard when entering room from overhead.

iii. Extend conduits 3 inches above finished floor.

iv. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

4. Installation of Cables:

A. Comply with NECA 1.

B. General Requirements for Cabling:

i. Comply with TIA/EIA-568-B.1.

ii. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

iii. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

iv. Cables may not be spliced. 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.

v. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

vi. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.

vii. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

viii. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

ix. In the communications equipment room, install a 10-foot-long service loop on end of each cable.

x. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

i. Comply with TIA/EIA-568-B.2.

ii. Do not untwist UTP cables more than 0.5 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

i. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

ii. Install UTP cable in cable tray where applicable.

iii. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

iv. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

i. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

ii. Coordinate separation with Division 26 contractor.

iii. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

iv. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2.5 inches.

v. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: No requirement.

vi. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

vii. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

27-9 AUXILIARY CABLING:

a) HDMI cables shall be Category 2 high speed, redmere, active HDMI cable in length as required for application. Provide jacks and combine with box and coverplate per other specification sections.

END OF SECTION 27

SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: clearing and grubbing the site of undesirable material such as grass, shrubs, trees, other plant life, and debris in preparation for grading activities.

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 temporary erosion and sedimentation control procedures.
   2. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
   3. Division 02 Section “Site Demolition.”
   4. Division 31 Section “Excavation and Fill.”

1.2 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 1 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 EXISTING CONDITIONS

A. Site conditions, as depicted on the project drawings, are shown based on available information. The Contractor shall visit the site to familiarize themselves with the existing conditions and verify existing conditions as depicted on the project drawings. The Contractor shall notify the Owner or the Owner’s Representative of any discrepancy between plan and field conditions and shall assume full responsibility for conditions encountered.

1.5 PROTECTION

A. Adjacent Properties: Protect adjacent properties during site clearing operations. Site clearing shall be limited to Owner’s property; any clearing which takes place outside of the Owner’s property shall be the Contractor’s responsibility to repair, at no additional cost to the Owner. The Contractor shall also protect existing structures on adjacent properties; including by not limited to fences, utility lines, manholes, catch basins, valve boxes, poles,

guys and other appurtenances. Damage done to structures on adjacent properties shall be the Contractor's responsibility to repair, at no additional cost to the Owner.

B. 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.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 CLEARING AND GRUBBING

A. Clearing shall consist of: cutting, removing, and disposing of trees, snags, stumps, shrubs, brush, limbs, and other vegetative growth; clearing shall also include the preservation of trees, shrubs, and vegetative growth, which are not designated to be removed.

B. Grubbing shall consist of the removal and disposal of wood or root matter below the ground surface remaining after clearing and shall include stumps, trunks, roots, or root systems greater than two inches in diameter to a depth of two feet below the natural ground surface.

C. All surface vegetation, trees, stumps, roots, and other protruding objects shall be cleared and grubbed, including required mowing. Undisturbed and sound stumps and nonperishable solid objects located more than two feet below subgrade and slope embankments may remain in place. When authorized, stumps and nonperishable solid objects that are located more than one foot below the ground line may remain if they are located outside the construction limits of excavation and embankment areas.

D. Depressions and cavities resulting from removal of obstructions shall be backfilled and compacted with suitable material as outlined in the project drawings, specifications, and/or Geotechnical Engineering Report, unless further excavation or earthwork is indicated.

E. Disposal of material and debris shall be done under applicable Federal, State, County, and City laws, ordinances, and regulations.

F. Stumps and large timbers shall be removed from the site and legally disposed of by the Contractor.

G. Tree Removal: In general, do not remove existing trees, whether shown on the project drawings or not, that are not in any way of the work or any future installation. Before proceeding with actual clearing operations, identify by an appropriate and clearly recognizable marker trees specifically intended to be preserved. Notify the Owner in

writing when trees to remain have been marked; do not remove any trees until the Owner has approved proposed tree protection and planned removal.

H. Coordination: Complete clearing of the site before topsoil stripping operations are begun. Do not leave loose sticks, roots, branches, or any other debris on the site. Avoid mixture of foreign matter with the topsoil.

3.2 PROTECTION OF EXISTING TREES

A. Throughout construction, properly protect existing trees and vegetation, which are to remain, to be relocated, or which overhang the property line.

B. Do not cut low hanging branches on trees to be saved, unless approved by the Owner. Cut branches which must be cut to eliminate obstructions. Immediately and properly trim any cuts, or accidental injuries to the bark or trunk, and properly trim and paint with a protective tree wound and sealing compound.

C. Permit no stripping of topsoil, cutting or filling, dumping of materials, storage of materials or equipment of any kind, or use by personnel for any activities, whether on or off duty, within the drip line of trees to remain.

END OF SECTION 311000

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 – GENERAL

1. SUMMARY

A. Section includes, but is not limited to, excavation, filling, compacting, and grading in the areas shown on the project drawings to obtain the required subgrade surface properly prepared to receive rock surfacing, pavements, walks, building floor slabs, utilities, drainage structures, or topsoil.

B. Section includes the spreading of topsoil in sufficient quantities to backfill islands, medians, roadway shoulders, and open graded areas.

C. Related Sections include the following:
   1. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
   2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
   3. Division 31 Section "Erosion and Sedimentation Controls" for temporary erosion and sedimentation control measures.
   4. Division 31 Section "Turf Base and Drainage" for turf base preparation.
   5. Division 32 Section "Turf and Grasses."

2. DEFINITIONS

A. Backfill: Soil materials placed over bedding to fill a trench or used to fill and excavation.

B. Base Course: Layer placed between the subgrade and paving.

C. Bedding: Aggregate materials placed over the excavated subgrade in a trench before laying pipe and placed beside and over pipe in a trench; including haunches to support sides of pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect/Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction of Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at the Contractor's expense.

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 ¾ cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent testing agency, according to ASTM D 1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other mam-made, stationary features above or below the ground surface.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage course, or topsoil materials.

K. Utilities include on-site, underground pipes, conduits, ducts, and cables.

3. SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated.
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.

B. Material Certifications: Gradations from manufacturer for subbase, base, engineered fill, bedding, drainage fill, and/or filler material as necessary.

4. QUALITY ASSURANCE

A. Standards:

   1. American Society of Testing and Materials (ASTM):
      D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft)
      D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
      D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3(2,700 kN-m/m3))
      D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
      D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
      D 2937 - Standard Test Method for Density of Soil in Place by the DriveCylinder Method
      D 4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
      D 4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

2. American Association of State Highway and Transportation Officials Standard Method of Test (AASHTO):

   T-96 - Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact by the Los Angeles Machine.
   T-99 - The Moisture-Density Relations of Soils Using a 2.5 kG (5.5 lb) Rammer and a 305 mm (12 in) Drop.
   T104 - Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate Test.

B. Testing:
   1. If needed per the Owner's sole judgment, a qualified geotechnical testing agency shall be retained to perform all required field and laboratory soil testing necessary to demonstrate compliance with this specification as outlined below in Field Quality Control.
   2. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient quantities of satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: As defined by the Geotechnical Engineering Report. In the absence of a Geotechnical Engineering Report the following shall be considered satisfactory soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: As defined by the Geotechnical Engineering Report. In the absence of a Geotechnical Engineering Report the following shall be considered unsatisfactory soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Base: Aggregate for base shall be essentially limestone or dolomite. The aggregate shall not contain more than 15 percent deleterious rock and shale. Sand may be added only for the purpose of reducing the plasticity index of the fraction passing the No. 40 sieve in the finished product. Any sand, silt and clay and any deleterious rock and shale shall be uniformly distributed throughout the material. The fraction passing the No. 40 sieve shall have a maximum plasticity index of six (6). The aggregate shall be in accordance with the following gradation requirements: 100 percent passing the 1 inch sieve, 60-90 percent passing the 1/2 inch sieve, 35-60 percent passing the No. 4 sieve, and 10-35 percent passing the No. 30 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; 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: Embedment for ordinary trench conditions is compacted, dense graded, clean, manufactured and processed aggregates described as angular crushed stone, crushed rock, crushed gravel, or crushed stone/sand mixtures containing little or no fines with 100 percent passing a 1 inch sieve, 55-90 percent passing a 1/2 inch sieve, 8-40 percent passing a No. 4 sieve, 0-15 percent passing a No. 10 sieve, and 0-4 percent passing a No. 200 sieve.

H. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate Size 57; with 100 percent passing a 1-1/2 inch sieve, and 0-5 percent passing a No. 8 sieve.

I. Filler 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 0-5 percent passing a No. 4 sieve.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

K. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of four (4) percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

2.2 SOIL STABILIZATION MATERIALS

A. Typical Materials: Code L, Quicklime, Cement, Flyash

2.3 ACCESSORIES

A. 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 PREPERATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section “Site Demolition” and Division 31 Section “Site Clearing.”

C. Protect subgrades and foundations soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

D. Provide erosion control measures as specified in Section 312500 Erosion and Sedimentation Controls.

3.2 TOPSOIL STRIPPING

A. Remove topsoil from areas within limits of excavation, trenching, borrow and areas designed to receive embankment or compacted fill.

B. Scrape areas clean of all brush, grass, weeds, roots, and other unsuitable materials before stripping topsoil.

C. Strip topsoil to a minimum depth of 6 inches, and to a sufficient depth to remove excessive roots in heavy vegetation or brush areas and as required to segregate topsoil.

D. Stockpile topsoil reasonably free of subsoil, debris, and stones larger than 2 inch diameter. Place stockpile such that it does not interfere with construction operations and existing facilities. Proper drainage of the stockpile shall be maintained. The stockpile shall be protected by erosion control BMPs to prevent sedimentation during runoff. Cover to prevent windblown dust.

E. The Contractor should anticipate that any topsoil stripped from the site and not required to complete site improvements is to be hauled off site and disposed of. However, the Owner retains the right to retain any topsoil prior to removal.

3.3 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 the greater of 24 inches wider than pipe or 42 inches wide.

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; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
      a. Intermittent drilling; blasting, if permitted; 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 the greater of 24 inches wider than pipe or 42 inches wide.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate area adequate to permit erection and removal of forms.

B. Trim to neat lines where concrete is to deposited against earth.

C. Excavate by hand in areas where space and access will not permit use of machines.

D. Restore bottom of excavation to proper elevations in areas over excavated as follows:
   1. For structures supported by piles or caissons, with compacted embankment.
   2. For structures supported by concrete footings or mats, with concrete.

E. Excavate rock, where encountered, to a distance of at least three (3) feet away from outside of structure walls. Bench additional rock excavation required for stability during construction to maintain vertical cuts. Perform such additional excavation and furnish any additional backfill subsequently required at no extra cost to Owner.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations. Excavate trenches to allow installation of top of pipe below the frost line.

B. Do not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is shorter) shall be the maximum length of open trench permitted on any line under construction.

C. Excavate trenches to uniform widths to provide a working clearance on each side of the pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than the top of pipe or conduit unless otherwise indicated.

D. Excavate trenches six (6) inches deeper than bottom of pipe elevation to allow for bedding. Hand excavate for bell of pipe if applicable

E. 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.

3.7 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding the Project site and surrounding areas.

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 excavations as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
   3. Discharge removed water to approved drains or channels. Contractor shall obtain State or local permits for discharge if such are required. Water discharge into streams shall be free of silt or other objectionable materials. Discharge water so that the work in progress and other properties are not damaged. Do not interfere unduly with the use of streets, alleys, private drives, or entrances.
   4. Remove unsuitable, excessively wet materials and replace with approved material.

3.8 SUBGRADE PREPARATION

A. Excavate or place embankment as required to construct subgrades to elevations and grades indicated.

B. Remove all unsuitable material and replace with approved embankment material. Perform all wetting, drying, shaping, and compacting required to prepare a suitable subgrade.

C. Roughen subgrade for embankment by discing or scarifying and wet or dry the top 6 inches as required to ensure bond with embankment.

D. Extend subgrade the full width of surfaced areas plus one foot.

E. Compact the top 12 inches of subgrades for traffic areas and slabs on grade to 95 percent of maximum density (ASTM D 698).

F. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect/Engineer, without additional compensation.

G. Proof-roll subgrade after moisture conditioning and compaction to identify soft or disturbed areas. Do not proof-roll wet or saturated subgrades. Proof-rolling will conform with the following:
    1. Use a fully loaded tandem axle dump truck or equipment providing an equivalent loading of not less than 20 tons for proof-rolling.
    2. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction.
    3. Limit vehicle speed to 3 mph.
    4. Undercut and replace soft areas, identified by proof-rolling, with approved fill material.

3.9 EMBANKMENT

A. Place embankment to the contours and elevations indicated in the project drawings. Place embankment material in lifts not exceeding eight (8) inches, uncompacted depth.

B. When rocks larger than four (4) inches are present, they shall be scattered and thoroughly consolidated with sufficient compacted soil to completely fill all voids between rocks. Exclude rocks larger than one half the depth of the lift from the top two (2) feet of the embankment.

C. Uniformly moisten or aerate each lift before compaction to within two (2) percent optimum moisture content. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by two (2) percent and is too wet to compact to specified density.

D. Embankment shall be compacted to 95 percent of maximum density at optimum moisture content as determined by ASTM D 698.

3.10 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 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.

3.11 UTILITY TRENCH BACKFILL

A. Place and compact initial bedding on trench bottoms and where indicated. Shape bedding to provide continuous support for bells, joints, and barrels of pipes and for joints fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Place and compact bedding materials, to a minimum height of 6 inches over the utility pipe or conduit.

D. Carefully compact material under pipe haunches and bring bedding 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 utility testing.

F. Fill voids with approved backfill materials while shoring and braking, and as sheeting is removed.

G. For areas not under pavement, place and compact final backfill of satisfactory soil material to final subgrade.

H. No rock greater than one (1) foot, measured in any direction, shall be placed within two (2) feet of the top of a pipe in any backfill. No rocks greater than one (1) foot will be allowed in the backfill above service line terminations, tees, or wyes.

I. For areas under pavement, place and compact final backfill using bedding material to final subgrade.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavement and slabs.

3.12 SOIL FILL

A. Disk, 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 with satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 0 to 4 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.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil 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 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 D698:
   1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
   3. Under lawn or unpaved areas, scarify and compact each layer of backfill or fill soil material at 90 percent. Do not compact top 12 inches.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.
   5. Moisture content at the time of placement shall be maintained between 0 and +4 percent of optimum moisture.

3.15 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 Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 0.1 feet.
   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.

3.12 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a six (6) inch course 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 six (6) inches. Compact each course of filter material to 95 percent of maximum dry unit weight according to ASTM D 698.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least six (6) inches. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 698. Place and compact impervious fill material over drainage backfill to final subgrade.

3.13 BASE COURSE

A. Under pavements and walks, place base course on prepared subgrade and as follows:
   1. Place base course material over compacted subgrade.
   2. Compact base courses 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 1557.
   3. Shape base to required crown elevations and cross-slope grades.
   4. When thickness of compacted base course is six (6) inches or less, place materials in a single layer.
   5. When thickness of compacted base course exceeds six (6) inches, place materials in equal layers, with no layer more than six (6) inches thick or less than three (3) inches thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.14 DRAINAGE COURSE

A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
   1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
   3. When compacted thickness of drainage course is six (6) inches or less, place materials in a single layer.
   4. When compacted thickness of drainage course exceeds six (6) inches, place materials in equal layers, with no layer more than six (6) inches or less than three (3) inches thick when compacted.

3.15 TOPSOIL PLACEMENT

A. Prior to the start of finish grading, the soil shall be fine graded. The grade shall be smooth without high spots or low spots and shall be free of construction debris. The site shall be weed free and ready for finish grading.

B. Place topsoil on all disturbed areas not scheduled to receive permanent surfacing.

C. Clear areas to receive topsoil of vegetation heavy enough to interfere with proper grading and tillage operations.

D. Clear surfaces of all stones or other objects larger than 3 inches in thickness or diameter, all roots, brush, wire, grade stakes, or other objectionable material.

E. Loosen subgrade by discing or scarifying to a depth of 2 inches wherever compacted by traffic or other causes to permit bonding of the topsoil to the subgrade.

F. Distribute topsoil over required areas without compaction other than that obtained with spreading equipment.

G. Place not less than four (4) inches of top soil over areas to receive topsoil.

H. Shape cuts, fills, and embankments to contours indicated in project drawings.

I. Grade to match contours of adjacent areas and permit good natural drainage.

J. Grade a gentle mound over trenches.

K. After spreading topsoil, clear surface of stones or other objects larger than two (2) inches in thickness or diameter and of objects that might interfere with planting and maintenance operations.

3.16 FIELD QUALITY CONTROL

A. Owner shall engage geotechnical engineer to perform field quality control testing. Contractor shall allow geotechnical testing agency to inspect and test subgrades and each embankment, fill, or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

B. 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 Engineer.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at a minimum 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 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two (2) tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two (2) tests.

D. When testing agency reports that subgrades, fills, embankments, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 MAINTENANCE AND REPAIR

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Settling or erosion shall be filled, repaired and grades reestablished to elevations and slopes indicated.

C. Correction of Settlement:
1. Settlement of embankments, backfill, or trenches occurring within the one-year correction period after Final Acceptance shall indicate defective work and shall be promptly corrected.
2. Contractor shall correct settlement and damages arising from or attributable to the settlement.
3. Make repairs within thirty (30) days from and after due notification by Owner of embankment or backfill settlement and resulting damage.
4. Make own arrangements for access to the site for purposes of correction and maintenance of corrected areas.

3.18 DISPOSAL

A. Remove surplus soil and waste material, including unsatisfactory soil, trash and debris and legally dispose of it off Owner’s property.

3.19 BLASTING

A. Blasting will not be permitted on this project.

END OF SECTION 312300

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: temporary and permanent management practices as shown on the project drawings, and indicated in the Storm Water Pollution Prevention Plan (SWPPP), and as directed by the Owner during the life of the Contract to control erosion, storm water runoff, and sedimentation.

B. Coordinate temporary erosion control provisions with permanent erosion control features to assure economical, effective, and continuous erosion, sedimentation, and pollution control throughout the construction and stabilization period.

C. Management practices required are not limited to the measures shown on the project drawings and indicated on the SWPPP. Provide additional practices necessitated by actual conditions and methods.

D. Silt and pollution leaving the site and any effects of the release are the sole and total responsibility of the Contractor as Primary, Secondary, or Tertiary Permittee or Operator.

E. Provide Subcontractors with a copy of the Erosion Control Plan and the SWPPP. Post notices requiring Subcontractors to review and comply with the Erosion Control Plan and the SWPPP.

1.2 RELATED DOCUMENTS

A. Conform to the Federal Clean Water Act, as well as the State clean water and erosion control regulations, and the rules and regulations promulgated to each of these Acts.

1.3 DEFINITIONS

A. This partial list of definitions is provided for the Contractor's convenience only. Obtain copies of the reference documents and learn appropriate terms required to fully implement the Erosion Control Plan and SWPPP.

B. Terms Defined:
   1. Best Management Practices (BMPs): Schedules of activities, prohibitions or practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State and/or the United States of America. BMPs include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.
   2. General Contractor: The operator of the common development or site.
   3. Nephelometric Turbidity Unit (NTU): A numerical unit of measure based upon photometric analytical techniques for measuring the light scattered by fine particles of a substance in suspension.

4. NPDES: National Pollution Discharge Elimination System.
5. Operator: The entity that has the primary day-to-day operational control of those activities at the facility necessary to ensure compliance with Erosion Control Plan and SWPPP requirements and permit conditions.
6. Primary Permittee: The Owner and the operator of a tract of land for a common development, or of a stand-alone facility that is not part of a common development; or a utility company when it is the only entity conducting a construction activity on a piece of property.
7. Qualified Personnel: A person who has successfully completed an erosion and sediment control short course eligible for continuing education units, or an equivalent course approved by EPD ant the State Soil and Water Conservation Commission.
8. Sediment: Solid material, both organic and inorganic, that is in suspension, is being transported, or has been moved from its site of origin by, wind, water, ice, or gravity as a product of erosion.
9. Waters of the State: Rivers, streams, creeks, branches, lakes, reservoirs, ponds, drainage systems, springs, wells, wetlands, and other bodies of surface or subsurface water, natural or artificial, lying within or forming a part of the boundaries of the state which are not entirely confined and retained completely upon the property of a single individual, partnership, or corporation.

1.4 QUALITY ASSURANCE CRITERIA

A. Project Review: Prior to the preconstruction conference, the Contractor shall review in detail the Erosion Control Plan and the SWPPP.

B. Preconstruction Conference: At the preconstruction conference submit for acceptance a detailed schedule for accomplishment of temporary and permanent erosion control work and installation of BMPs, for clearing and grubbing, grading, construction, paving, and other project activities. Submit for acceptance a proposed method of erosion control for haul roads and borrow pits and a plan for disposal of waste material. Do not begin work until the erosion control schedules and methods of operations have been accepted by the Owner.

C. Provide qualified personnel to supervise provision and maintenance of management practices.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Silt Fence

1. Filter Fabrics: Use filter fabric composed of strong, rot-proof synthetic fibers formed into a fabric of either woven or non-woven type. Use fabric free of any treatment or coating which might significantly alter its physical properties. Use fabric containing stabilizers or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat. Use a pervious sheet of

synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other. Finish the edges of the fabric to prevent the outer yarn from pulling away from the fabric. Use fabric free of defects or flaws which significantly affect its physical and/or filtering properties. Use fabric with a minimum width of 36 inches. Sew or bond sheets of fabric together. No deviation from any physical requirements will be permitted due to the presence of the seam.

2. Woven Wire Fence: Wire fence fabric at least 32 inches high, with at least 6 horizontal wires. Vertical wires spaced 6 inches apart. Top and bottom wires at least 10 gage. Other wires at least 14 gage.
3. Posts: Straight steel posts, 1.33 pounds per linear foot min., 5 feet long, at 4 feet max. o.c., 1-3/4 inches wide, which have projections for fastening the wire to the fence.
4. Wire staples: Wire No. 9 staple at least 1 ½ inches long.

B. Silt Socks

1. Silt Sock shall be SiltSoxx® by Filtrexx® or approved equal.

C. Mats and Blankets

1. Jute or Hemp Mat: Woven, 76 to 80 warpings per 4 foot width, 39 to 43 weftings per 3 foot length, 0.9 pounds per square yard minimum, 1.5 pounds per square yard maximum.
2. Excelsior Blanket: 80% of fibers 6” min. length, smolder resistant, photo-degradable plastic mesh, maximum 1-1/2 x 3 inches, ¼ inch min. thickness, 0.8 pounds per square yard.
3. Coconut Fiber Blanket: 100% coconut, ¼” min. thickness, 48” min. width, 0.5 pounds per square yard, photo-degradable plastic mesh 5/8” x 5/8” maximum.
4. Wood Fiber Blanket: Free of germination inhibitors, photo-degradable plastic mesh, 5/8” x ¾” max. spacing, 0.35 pounds per square yard minimum dry weight.

D. Polymers

1. Anionic polyacrylamide soil binding agents, environmentally benign, 0.05% monomer by weight.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install BMPs in accordance with the Erosion Control Plan and SWPPP.

B. Maintain BMPs throughout construction and until the site is finally stabilized.

C. Implement or assist the Owner with implementation of the SWPPP.

D. Submit reports as required by the local jurisdiction, state, and federal government.

E. Retain records as required by local, state, and federal authorities.

F. Submit or assist the Owner with submittals of applicable permits and termination of permits.

3.2 SCHEDULE

A. Temporary construction entrance(s), silt fences, straw bale dikes, or other initial sediment controls shown on the project drawings must be installed prior to any other work.

B. Sediment basins must be installed within 10 calendar days after construction begins or as soon as 2 or more acres are disturbed, whichever comes first.

3.3 METHODS

A. Several methods of controlling dust and other pollutants include, but are not limited to, the following:

1. Exposing the minimum area of erodible earth.
2. Applying temporary mulch with or without seeding.
3. Using water sprinkler trucks.
4. Using covered haul trucks.
5. Using dust palliatives or penetration asphalt on haul roads.
6. Using plastic sheet coverings.
7. Using gravel.

3.4 AUTHORITY OF ENGINEER

A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, and borrow and fill operations.

B. The Engineer has the authority to direct the Contractor to provide immediate permanent or temporary erosion control measures to minimize loss of soil due to erosion and contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

3.5 CONSTRUCTION

A. Prior to clearing and grubbing operations for the project. Contractor shall identify all areas where the potential for loss of soil due to erosion exists, and shall line the downhill side of the construction site within these areas with straw bales or silt fences to minimize eroded materials from leaving the site. These shall be maintained throughout the construction period and removed when the permanent ground covering is established.

B. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the

permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available.

C. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

D. When erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

E. The Contractor will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. If disturbance occurs outside scheduled areas or anticipated work zones, or if weather conditions delay permanent control measures, temporary erosion control measures shall be taken immediately.

3.6 MAINTENANCE

A. Maintain temporary management practices until no longer needed or permanent management practices are provided and the site is stabilized. Remove temporary materials.

B. In the event that temporary management practices are required due to negligence, carelessness, or failure to provide permanent management practices as a part of work as scheduled, provide at no cost to the Owner.

C. When silt deposited in sediment basins occupies more than 30% of the basin capacity, remove the silt. Remove the silt from the site unless otherwise permitted by the Owner. Restore the basin to the conditions and grades as shown on the Drawings.

END OF SECTION 312500

SECTION 313116 - TERMITE CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Chemical soil treatment.

1.2 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act 2006.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

C. Include the EPA Registered Label for termiticide products.

D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.4 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year installer's warranty against damage to building caused by termites.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.

B. Manufacturers:

1. Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.Bayer Environmental Science Corp: www.backedbybayer.com/pest-management/#sle.
2. BASF Corporation
3. Ensystex, Inc.

C. Mixes: Mix toxicant to manufacturer's instructions.

D. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Verify final grading is complete.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove 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 within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

3.3 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

C. Apply toxicant at following locations:

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.

D. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

E. Re-treat disturbed treated soil with same toxicant as original treatment.

F. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

G. Post warning signs in areas of application

3.4 PROTECTION

A. Do not permit soil grading over treated work.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

END OF SECTION

SECTION 32 11 00
CAST-IN-PLACE CONCRETE FOR SITEWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for the following:
   1. Roads, parking lots, sidewalks, curbs and gutters, etc.
   2. Sanitary Structures, Wet Wells, Valve Vaults, Meter Pits, etc.

1.2 RELATED SECTIONS

A. Division 31 Section “Excavation and Fill”

1.3 REFERENCES

A. American Concrete Institute:

1.	ACI 301	Specifications for Structural Concrete
2.	ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete.
3.	ACI 305R	Hot Weather Concreting
4.	ACI 306R	Cold Weather Concreting
5.	ACI 306.1	Standard Specification for Cold Weather Concreting
6.	ACI 308	Standard Practice for Curing Concrete
7.	ACI 347	Guide to Formwork for Concrete

B. American Society for Testing & Materials:

1.	ASTM B 221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
2.	ASTM C 33	Concrete Aggregate
3.	ASTM C 94	Ready-Mixed Concrete
4.	ASTM C 150	Portland Cement
5.	ASTM C 260	Air Entraining Admixtures for Concrete
6.	ASTM C 494	Chemicals Admixtures for Concrete
7.	ASTM C 595M	Blended Hydraulic Cements (Metric)
8.	ASTM C 1017	Chemical Admixtures for Use in Producing Flowing Concrete
9.	ASTM C 1107	Packaged Dry, Hydraulic Cement Grout (Nonshrink)
10.	ASTM D 994	Performed Expansion Joint Filler for Concrete
11.	ASTM D 1190	Concrete Joint Sealer, Hot-Poured Elastic Type
12.	ASTM D 1751	Preformed Expansion Joint Filler for Concrete Paving
13.	ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving

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.

C. Shop Drawings: 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. Mill Certificates: Steel producer's certificates of mill analysis, tensile, and bend tests for reinforcing steel, when requested.

E. Construction Joint Layout: Submit a Joint Plan, showing type and location, no smaller than the scale of the project drawings. Joint Details, including dowels, where appropriate. Sealer manufacturer's information.

F. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious Materials
   2. Admixtures
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories
   5. Fiber reinforcement
   6. Joint-filler strips
   7. Waterstops
   8. Repair Materials

G. Contractor should be aware that other submittal requirements (i.e. shop drawings) are contained in other applicable sections of these specifications.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: a qualified installer who employs on the 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, acceptable to authorities having jurisdiction and 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 and 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 single source, and obtain admixtures from single source from a single manufacturer.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcement to the job site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on shop drawings.

B. Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

C. Handle reinforcement in such a way to prevent bending and damage.

PART 2 – PRODUCTS

2.1 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 materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and High-density overlay, Class 1 or better.

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. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

F. 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.

G. 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 dampproofing or waterproofing.

2.2 STEEL REINFORCMENT

A. Reinforcing Bars: Comply with ASTM A 305, Deformed Bars. Conforming to ASTM 615, Grade 60, or ASTM 706, Grade 60 as indicated on the project drawings.

B. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Plain Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

E. Deformed Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, grade 60, plain steel bars, cut true to length with ends square and free of burrs.

B. Supports for Reinforcement: Bolster, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than the concrete 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.

2.4 MATERIALS

A. Cementitious Materials:

    1. Cement shall be a standard brand Portland cement which shall conform to ASTM C 150. Type I cement with Fly Ash conforming to ASTM C 618, Class F.

2. Use cement of the same type, brand, and source throughout the project.

B. Water: ASTM C 94/C 94M and potable.

C. Fine Aggregate:

1. Fine Aggregate shall consist of natural sand, manufactured sand, or a combination thereof. The gradation requirements of fine aggregate shall be as follows: 100 percent passing the 3/8 inch sieve, 95-100 percent passing the No. 4 sieve, 40-80 percent passing the No. 16 sieve, 5-30 percent passing the No. 50 sieve, and 0-10 percent passing the No. 100 sieve.
2. Fine Aggregate shall conform to the requirements of ASTM C 33 with respect to deleterious substances, soundness, and abrasion.

D. Course Aggregate:

1. Course Aggregate shall consist of crushed stone or crushed gravel of uniform quality. The gradation requirements of course aggregate shall be as follows: 100 percent passing the 1 inch sieve, 90-100 percent passing the 3/4 inch sieve, 40-60 percent passing the 1/2 inch sieve, 10-30 percent passing the 3/8 inch sieve, and 0-5 percent passing the No. 4 sieve.
2. Course Aggregate shall conform to the requirements of ASTM C 33 with respect to deleterious substances, soundness, and abrasion.

E. Admixtures:

1. Air-Entraining Admixture: ASTM C 260.

2. Chemical:
    a. ASTM C 494 Type A – Water Reducing
    b. ASTM C 494 Type B – Retarding
    c. ASTM C 494 Type C – Accelerating
    d. ASTM C 494 Type D – Water Reducing and Retarding
    e. ASTM C 494 Type E – Water Reducing and Accelerating
    f. ASTM C 494 Type F – Water Reducing, High Range
    g. ASTM C 494 Type G – Water Reducing, High Range and Retarding

3. Plasticizing: ASTM C 1017.

4. Use only admixtures that have been tested and accepted in mix designs and with Engineer's approval.

5. Comply with ACI 212.1 R "Admixture for Concrete" and ACI 212.2R-81 "Guide for Use of Admixture in Concrete.

F. Waterstops

1. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
    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:
        i. Greenstreak.
        ii. Williams Products, Inc.
    b. Profile: Flat dumbbell without center bulb.
    c. Dimensions: 4 inches by 3/16 inch thick, nontapered.

G. Curing Materials:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
    a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    b. BASF Construction Chemicals - Building Systems; Confilm.
    c. ChemMasters; SprayFilm.
    d. Conspec by Dayton Superior; Aquafilm.
    e. Dayton Superior Corporation; Sure Film (J-74).
    f. Edoco by Dayton Superior; BurkeFilm.
    g. Euclid Chemical Company (The), an RPM company; Eucobar.
    h. Kaufman Products, Inc.; Vapor-Aid.
    i. Lambert Corporation; LAMBCO Skin.
    j. L&M Construction Chemicals, Inc.; E-CON.
    k. Meadows, W. R., Inc.; EVAPRE.
    l. Metalcrete Industries; Waterhold.
    m. Nox-Crete Products Group; MONOFILM.
    n. Sika Corporation; SikaFilm.
    o. SpecChem, LLC; Spec Film.
    p. Symons by Dayton Superior; Finishing Aid.
    q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    r. Unitex; PRO-FILM.
    s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

4. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:
    a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. BASF Construction Chemicals - Building Systems; Kure 200.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec by Dayton Superior; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    f. Edoco by Dayton Superior; Res X Cure WB.
    g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.

h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

H. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

I. Contractor Joint Sealing Compound shall be one of the following:

1. Cold pour polymer fortified crack fill material generally conforming with ASTM D 1190.
2. Hot pour polymer rubber asphalt sealer meeting the requirements of ASTM D 3405. A certification will be required from the Contractor certifying that the joint sealer meets this specification.

J. Accessories:

1. Vapor Retarder: 10-mil thick clear polyethylene film/mildew resistant, type recommended for below grade application. Overlap (8 inch min.) and watertight-seal all joints.
2. Non-Shrink Grout: CDC-C 588, factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,000 psi in 48 hours and 7,000 psi in 28 days.
3. Non-Shrink Grout, Non-Metallic Grout: Factory premixed grout conforming to CRD-C-621-80, “Corps of Engineers Specification for Non-Shrink Grout.”
    a. Acceptable Manufacturers:
    EUCO NS, The Euclid Chemical Company
    Sonogrout, Sonneborn-Contech
    Masterflow 713, Master Builders
    Duragrout, L & M Construction Chemical Co.

2.5 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. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows: Fly Ash: 20 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

E. Use admixtures according to manufacturer's written specifications.

2.6 CONCRETE MIXTURES

A. Roads, Parking Lots, Sidewalks, Curbs & Gutters:

1. Minimum Compressive Strength: 4,000 psi at 28 days.
2. Maximum Water-Cementitious Material Ration: 0.45.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: Between 5 and 7 percent at point of delivery.

B. Sanitary Structures, Wet Wells, Valve Vaults, Meter Pits, etc.:

1. Minimum Compressive Strength: 4,000 psi at 28 days.
2. Maximum Water-Cementitious Material Ration: 0.44.
3. Slump Limit: 4 inches plus or minus 1 inch.
4. Air Content: Between 5 and 7 percent at point of delivery.

2.7 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.8 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. When air temperature is between 85 and 90 degrees F (29.4 and 32.2 degrees C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F (32.2 degrees C), reducing mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum type batch machine mixer.

1. For mixer capacity 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 mixer capacity 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, mixture time, quantity, and amount of water added. Record approximate location of final deposit in the project.

PART 3 – EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain framework according to ACI 301 and ACI 347.

B. Limit concrete surface irregularities, the maximum deviation of the top surface of any section shall not exceed one-eighth (1/8) inch, or the inside face not more than one-fourth (1/4) inch from planned alignment.

C. Construct forms tight enough to prevent loss of concrete mortar. Retighten forms and bracing before placing concrete, as required, to prevent concrete mortar leaks and maintain proper alignment.

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

E. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

F. Forms shall have a depth equal to greater than the prescribed edge thickness of the pavement slab. The minimum length of each section of form used shall be ten (10) feet. Each section or form shall be uniform and free from undesirable bends or warps.

G. Every ten (10) foot length of form shall have at least three (3) form braces which shall be spaced at intervals of not more than five (5) feet, having the end brace not more than six (6) inches from the end of the form. Approved flexible forms shall be used for construction where the radius is 150 feet or less.

3.2 REMOVING AND REUSING FORMS

A. General: Formwork may be removed after concrete has achieved at least 70 percent of its 28-day design compressive strength. Concrete has to be hard enough to not be damaged by form removal operations and curing and protection operations as outlined below.

B. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged from-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.

3.3 VAPOR RETARDERS & BARRIERS

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 fully seal with manufacturer's recommended tape.
    2. Tape around all penetrations & lap edges up over top of foundation wall a min. of 4".

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.4 STEEL REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

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.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.

F. The maximum angle bar that is intended to be straight may be bent or offset shall be at a slope of 6:1, longitudinal to transverse dimension.

G. If clearances for reinforcing require hooks shorter than standard hooks, fabricator shall be responsible for providing shorter hooks, as required to meet ACI requirements.

H. 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 sheets widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 CONCRETE PLACEMENT, GENERAL

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and subgrade preparation are complete and that required inspections and tests have been performed.

B. Do not add water to concrete during delivery, at project site, or during placement operations unless approved by the Engineer.

C. Before test sampling and placing concrete, water may be added at the project site, subject to the limitations of ACI 301.

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 place continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

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 pavement surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces as required in project drawings.

5. Limit durations of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 degrees F (4.4 degrees C) for three consecutive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. 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 degrees F (32.2 degrees C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provide water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete in 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.

G. No concrete shall be placed around manholes or other structures until they have been adjusted to the required grade and alignment.

3.6 INSTALLATION TOLERANCES

A. Surface Smoothness for Field Event Surfaces shall fall within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. 1/8 inch max in any direction, checked with a 10 foot straight edge

3.7 JOINTS

A. General: : Construct expansion, weakened ¬plane (contraction), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

B. Weakened Plane (Contraction) Joints: Provide weakened plane (contraction) joints, sectioning concrete into areas as shown on drawings or as indicated below. Construct weakened ¬plane joints for a depth equal to at least 1/4" wide x 1/4 of concrete thick¬ness, as follows:
   1. Tooled Joints: Form weakened plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
   2. Sawed Joints: Sawed joint WILL NOT BE ALLOWED.

3. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
4. Unless indicated otherwise on the drawings. Weaken¬ed-plane joints shall be placed at maximum 5 ft. intervals each direction and located to conform to bay spacing wherever possible, or as shown on drawings.

C. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than ½ hour, except where such placements terminate at expansion joints.
1. Construct joints as shown or, if not shown, use standard metal keyway-section forms.
2. Pinned Joints:
    a. Expansion joints, joints between new and existing (old) concrete shall be suitably pinned together prevent vertical misalignment.
    b. Joints between sidewalks and building or canopy slabs shall be suitably pinned together to prevent vertical misalignment.
3. Provide preformed galvanized steel keyway-section forms or bulkhead forms with keys, unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete.
4. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
5. Provide tie bars at sides of paving strips where indicated.
6. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

D. Expansion Joints: Use ASTM D 1751, non-extruding premoulded joint filler, 3/4" thick, composed of fiberboard impregnated with asphalt, for expansion joints abutting concrete curbs, catch basins, manholes, inlets, struc¬tures, walks, and other fixed objects, unless otherwise indicated.

E. Expansion Joints: At ramps and walks, use ASTM D 1751, non-extruding premoulded material, ½" thick, unless otherwise noted, composed of fiberboard impregnated with asphalt.

F. Locate expansion joints at intervals not greater than 50' unless indicated otherwise.

G. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished con¬crete surface.

H. Furnish joint fillers in one piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.

I. Protect top edge of joint filler during con¬crete placement with a metal cap or other temporary material. Remove protec¬tion after concrete has been placed on both sides of joint.

J. Fillers and Sealants: Comply with require¬ments of applicable Division 7 sections for preparation of joints, materials, installation, and performance.

3.8 FINISHING

A. Mechanical Finishing Machine Method:

1. The concrete shall be struck off at such a height that after consolidation and final finishing it shall be at the elevations as shown on project drawings.
2. A depth of excess concrete shall be carried in front of the strike off screed for the full width of the slab, whenever the screed is being used to strike off the pavement.
3. The finishing machine shall be provided with a screed, which will consolidate the concrete by pressure.
4. The concrete shall be brought to a true and even surface, free from rock pockets, with the fewest possible number of passes of the machine.
5. The edges of the screeds along the curb line may be notched out to allow for sufficient concrete to form the integral curb.
6. Hand finishing tools shall be kept available for use in case the finishing machine breaks down.

B. Hand Finishing Method:

1. The concrete shall be struck off and consolidated by a vibrating screed or other approved equipment to the elevations shown on the project drawings.
2. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off and not be allowed to idle in the concrete.
3. Internal mechanical vibration shall be used alongside all formed surfaces.
4. Vibration operation shall be completed prior to final hand finishing.

C. Floating, Straightening, and Edging:

1. After concrete has been struck off and consolidated, it shall be further smoothed by means of a wood or aluminum float at least five (5) feet wide with a handle long enough to reach the entire width of the slab being placed.
2. The float shall be operated so as to remove any excess water and laitance, as well as surface irregularities. After floating operation, the pavement surface should be within the specific tolerances.
3. While concrete is still plastic, the pavement surface shall be tested for smoothness with a ten (10) foot straight edge swung from handles three (3) feet longer than one half the width of the pavement.
4. The straight edge shall be placed on the surface parallel to the centerline of the pavement and at not more than five (5) foot intervals transversely. After each test, the straight edge shall be moved forward one half its length and the operation continued.
5. When irregularities are discovered, they shall be corrected by adding or removing concrete.
6. All disturbed areas shall be again floated with the wooded float and again straight edged.

7. The pavement shall have no depression in which water will stand.
8. Before final finishing is completed and before concrete has taken its initial set, the edges of the pavement shall be carefully finished with an edger of the radius shown on the project drawings.

D. Final Surface Finish:

1. A broom finish shall be used as the final finishing method. A hard bristle broom shall be used, which shall be kept clean and used in such a manner as to provide a uniform texture surface.
2. The final surface of the concrete pavement shall have a uniform gritty texture, free from excessive roughness and true to the grades and cross sections shown on the project drawings.
3. The Engineer may require changes in the final finishing procedure as required to produce the desired final surface texture.

3.9 PROTECTING AND CURING

A. 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. Begin curing immediately after finishing concrete as soon as marring of the concrete will not occur.

D. 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 (7) 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 tap or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
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 (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: after curing period had elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to pavement indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspection: Engage a qualified testing and inspection agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement. Contact the Engineer a minimum of 24 hours prior to the placement of concrete for his approval and observation of the placement of all reinforcing.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength.

C. Concrete Tests: Testing of composite samples of fresh concrete shall be obtained according to ASTM C 172 and as follows:

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 (5) compressive strength tests for each concrete mixture, testing shall be conducted from at least five (5) 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, 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.
4. Concrete Temperature: ASTM C 1064/C 1064M; one hourly test when air temperature is 40 degrees F (4.4 degrees C) and below or when air temperature is 80 degrees F (26.7 degrees C) or above; and one test for each composite sample.
5. Compressive-Strength Testing: ASTM C 39/C 39M.
   a. Test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

b. A compressive-strength test result shall be the average compressive strength from a set of two specimens obtained from the same composite sample and tested at the age indicated.

6. 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 values falls below specified compressive strength by more than 500 psi.
7. 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 inspection agency, location of concrete batch in work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, an type of break for both 7 and 28-day tests.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer, but will not be used as sole basis for approval or rejection of concrete.
9. 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 the Engineer.
10. Additional testing and inspection, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 321100

SECTION 32 12 16
ASPHALT PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: requirements and specifications for the construction of asphalt paving surfaces as shown on the Project Drawings.

B. The work includes providing paving base and final subgrade preparation and fine grading normally incidental to paving operations.

1.2 SUMMARY

A. This Section includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Asphalt surface treatments.
6. Imprinted asphalt.

B. Related Sections:

1. See Section 312300 Excavation and Fill for subgrade preparation and base course specifications.

1.3 DEFINITIONS

A. Refer to ASTM D 8-11, Standard Terminology Relating to Materials for Roads and Pavements for definitions of applicable terms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, include technical data and tested physical and performance properties.

1. Job Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix design proposed for the work.
2. Job Mix Designs: For each job mix proposed for the work.

B. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated.

1. Each paving fabric, 12 inches by 12 inches (300 mm by 300 mm) minimum.
2. Each type and color of preformed traffic calming device.
3. Each pattern and color of imprinted asphalt and precut marking material.

C. Qualification Data: For qualified manufacturer.

D. Material Certifications: For each paving material from manufacturer.

E. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving mix manufacturer registered with and approved by the Department of Transportation (DOT) of the state in which the project is located.

B. Installer Qualifications: Imprinted asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt.

C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the DOT of the state in which the project is located for asphalt paving work; with the following exceptions:

1. Measurement and Payment provisions and safety program submittals included in DOT standard specifications do not apply to this Section.

E. Pre-installation Conference: Contractor shall conduct a pre-installation conference at the project site to review methods and procedures related to hot-mix asphalt paving including but not limited to the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of subgrade and preparatory work.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 PROJECT CONDITIONS

A. 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 40 degrees F (4.4 degrees C).
2. Tack Coat: Minimum surface temperature of 40 degrees F (4.4 degrees C).
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 35 degrees F (1.7 degrees C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 40 degrees F (4.4 degrees C) and rising at time of placement.

B. Imprinted Asphalt Paving: Proceed with coating imprinted asphalt pavement only when air temperature is at least 50 degrees F (10 degrees C) and rising and is not expected to drop below 50 degrees F (10 degrees C) within eight (8) hours of coating application. Proceed only if no precipitation is expected within two (2) hours of final coating layer application.

PART 2 – PRODUCTS

2.1 AGGREGATE MATERIALS

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: All coarse aggregate shall consist of sound, durable rock, free from cemented lumps or objectionable coatings. The percentage of deleterious substances shall not exceed the values found in Missouri Department of Transportation (MoDOT) Section 1004.2.1. Coarse aggregate shall meet all requirements as outlined in MoDOT Section 1004.

C. Fine Aggregate: Fine aggregate for asphalt paving shall be a fine, granular material passing the 3/8 inch sieve, naturally produced by the disintegration of rock of a siliceous nature and/or manufactured by the mechanical reduction of sound durable rock in accordance with MoDOT Sections 1002.2.1.2 and 1002.2.2. Fine aggregate shall meet all requirements as outlined in MoDOT 1002.3.

D. Mineral Filler: Shall be in accordance with AASHTO M 17.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 85-100.

B. Asphalt Cement: ASTM D 3381 for viscosity graded material.

C. Prime Coat: Asphalt emulsion prime coat complying with the requirements of MoDOT Sections 408 and 1015.

D. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application. Grade SS-1 for SS-1H.

E. Fog Seal: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

F. Water: Potable

G. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide granular, liquid, or wettable powder form.

B. Sand: AASHTO M 29, Grade No. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 6690 Type II hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Hot-Mix asphalt: Dense, hot laid, hot mix asphalt plant mixes approved by MoDOT.
   1. Base Course: MoDOT Plant Mix Bituminous Base per MoDOT Specification Section 401.
   2. Surface Course: As specified on the project drawings, MoDOT Plant Mix Bituminous Pavement BP-1 or BP-2 per MoDOT Specification Section 401.

B. Emulsified Asphalt Slurry: ASTM D 3910, Grade SS-1 or SS-1H.

C. Use of cutback material is NOT allowed without written approval of the Engineer. If after 48 hours the asphalt is excessively soft or showing signs of alligatoring or cracking, movement or marking from vehicular traffic, then paving shall be removed and replace as directed by Engineer.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade per Section 31 23 00 Excavation and Fill.

C. Proceed with paving only after unsatisfactory conditions identified by proof-rolling have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

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 (38 mm).
   2. Mill to a uniform finished surface free of excessive gouges, groves, 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. Transport milled hot-mix asphalt to asphalt recycling facility.
   7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

A. Hot-mix asphalt pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into 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 reset 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 reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot mix asphalt paving at a rate of 0.05 to 0.15 gal/sq. yd. (0.2 to 0.7 L/sq. m).

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. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix asphalt surface course 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 (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/2 inch (12 mm).
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 (6 mm) 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 (6 mm) 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 dry, prepared subgrade or surface of compacted aggregate base before applying paving materials. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). 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 places and after volatiles have evaporated.
2. Protected primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal/sq. yd. (0.2 to 0.74 L/sq. m).

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 tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).

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 (100 mm) and transverse joints 6 inches (150 mm).

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.7 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness with 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 degrees F (121 degrees C).
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 (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, succeeding strips and extend rolling to overlap previous strips. 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 coats to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm),
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 rollers.

1. Complete compaction before mix temperature cools to 185 degrees F (85 degrees C).

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 AASHTO T 245, but not less than 94 percent nor 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 nor 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 properly 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 INSTALLATION TOLERANCES

A. Pavement Thicknesses: Compact each course to produce the thickness indicated on the project drawings within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), 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 (3 m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

C. Traffic Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

3.11 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow curing. 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 curing. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: 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. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four (4) 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.
3. One core sample will be taken for every 1,000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three (3) cores taken.
4. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2650 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from project site and legally dispose of them in an EPA approved landfill.

B. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 32 13 73
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.

B. Related Sections:

1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Pavement-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.

D. Qualification Data: For qualified Installer.

E. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

G. Preconstruction Compatibility and Adhesion Test Reports: From joint-sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility with and adhesion to joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

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 type of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

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.

PART 2 - PRODUCTS

2.1 MATERIALS

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.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

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. Crafco Inc., an ERGON company; RoadSaver Silicone.
b. Dow Corning Corporation; 888.

c. Pecora Corporation; 301 NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.

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. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Pecora Corporation; 300 SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

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. Pecora Corporation; Urexpan NR-200.

2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are 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.

2.4 PRIMERS

A. Primers: Product 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.

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.

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. General: 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 indicated.

C. Install joint-sealant backings of kind indicated 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 using proven techniques that comply with the following and at the same time backings are installed:

1. Place joint 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.

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

A. Clean off excess joint 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement.

1. Joint Location:

    a. Expansion and isolation joints in cast-in-place concrete pavement.
    b. Contraction joints in cast-in-place concrete slabs.
    c. Other joints as indicated.

2. Silicone Joint Sealant for Concrete: Single component, self-leveling.
3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.
4. Joint-Sealant Color: As selected by Architect from manufacturer's full range

B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.

1. Joint Location:

    a. Joints between concrete and asphalt pavement.
    b. Joints between concrete curbs and asphalt pavement.
    c. Other joints as indicated.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 321373

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Provide labor, material, and equipment necessary installation of pavement markings as shown on the Project Drawings.

B. Provide labor, material, and equipment necessary for the removal of existing pavement markings as shown to be removed on the Project Drawings.

1.2 SUBMITTALS

A. Manufacturer's Certificates and Data certifying that the paint, thermoplastic, and/or glass beads conform to the requirements specified.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement marking materials to project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

PART 2 – PRODUCTS

2.1 PAINT MATERIALS

A. Pavement Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.

B. Colors:

1. White Chip #37925
2. Yellow Chip #33538

C. Glass Beads: AASHTO M 247, Type 1.

2.2 THERMOPLASTIC MATERIALS

A. Thermoplastic materials shall conform to MoDOT Specification Section 620.

PART 3 – EXECUTION

3.1 PAINT INSTALLATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F (4.4 degrees C) for oil-based materials; 55 degrees F (12.8 degrees C) for water based materials; and not exceeding 95 degrees F (35 degrees C) for either.

C. Do not apply pavement marking paint until layout, colors, and placement have been verified with the Engineer.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

F. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb./gal. (0.72 kg/L).

3.2 THERMOPLASTIC INSTALLATION

A. Proceed with pavement marking only on clean, dry surfaces and at a minimum pavement surface temperature of 60 degrees F (15.6 degrees C) and a minimum ambient temperature of 50 degrees F (10 degrees C).

B. A primer shall be applied to bituminous surfaces over 2 months old and all concrete surfaces. Primer is not required on new bituminous surfaces unless recommend by the thermoplastic manufacturer. Primer shall be applied and cured in accordance with the recommendations of the thermoplastic manufacturer.

C. Temperature of the thermoplastic at the time of application shall be 400 – 425 degrees F (204.4 – 232.2 degrees C).

D. Furnished markings shall have well defined edges and be free of waviness.

3.3 PROTECTION

A. Conduct operations in such a manner that necessary traffic can move without hindrance.

B. Protect newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint.

3.4 REMOVAL OF MARKINGS

A. Preformed removable tape shall be removed by had methods.

B. Paint shall be removed from Portland cement concrete pavement by a high pressure water blast method, or a low pressure water and sand blast method, or a steel shot blast method.

C. Paint shall be removed from bituminous pavement by either a low pressure water and sand blast method or by a steel shot blast method.

D. Paint shall be removed without damaging the surface or texture and without leaving an image which might mislead traffic.

E. High pressure water blast methods shall not exceed 10,000 psi.

F. Low pressure water and sand blast methods shall not exceed 3,000 psi.

END OF SECTION 321723

SECTION 32 92 00
TURF AND GRASSES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: installation of the lawns and native grasses, and guarantee/warranty as shown on the project drawings and as specified herein.

B. Related Sections:
   1. Section 312300 Excavation and Fill contains Topsoil requirements.
   2. Section 312500 Erosion and Sedimentation Controls contains Erosion Control Blanket requirements.

1.2 GENERAL CONDITIONS

A. All scaled dimensions are approximate. Check and verify all site dimensions and receive Engineer's approval prior to proceeding with work under this section.

B. Coordinate installation of all sodding and seeding with Engineer, General Contractor and Irrigation Contractor, if applicable, to avoid interference with other construction.

C. Keep the premises clean and free of excess equipment, materials and debris incidental to work.

D. Protect work and work of others at all times in performance of work, Contractor shall be responsible for any damage to irrigation lines during construction

E. Carefully note all finish grades before commencing work. Restore any finish grade changed during the course of this work to original or intended grades.

F. All disturbed areas shall be hydroseeded except for sodded areas, surfaced areas and solid rock. Disturbed areas outside of authorized construction limits shall be hydroseeded, or sodded at the Contractor's expense.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage and experienced installer who has a minimum of ten years of experience in the sod and seeding industry and native grass industry. Installer shall have completed seeding work similar in material (size and quantity), design and extent to that indicated for this project and with a record of successful established seeded lawns and native grasses. Installer shall provide references of similar project size within the last five years.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Engineer's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work.

C. Topsoil Analysis: Furnish a soil analysis made by a qualified and approved independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand) deleterious material, pH, and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus and potash nutrients and any limestone, aluminum sulfate or other soil amendments to be added to produce satisfactory topsoil.

D. The Contractor or his authorized representative shall be on site at the time of each site inspection or review. If contractor requests a site inspection or review and the site is not found to be in an acceptable condition to hold the review, the hourly fees of the personnel called for the site visit shall be paid by the Contractor.

1.4 SUBMITTALS

A. Sod: The Contractor shall furnish to the Engineer a certification of the seed mixture of the sod, identifying sod source, including name and telephone number of supplier.

B. Seed: The Contractor shall furnish to the Engineer that dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety for approval, prior to seeding.

C. Organic Compost: The Contactor shall submit to the Engineer a certificate signed by the manufacturer of the organic compost certifying that the compost used during the seeding process complies with specified requirements.

D. Certification and mix composition of all seed and sod including seed and sod sources and rate of application, and name of supplier.

E. Qualification date for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, name and address of Engineers and Owners, and other information.

F. Material test reports from qualified and approved independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.
1. Analysis of existing surface soil.
2. Analysis of imported topsoil.

G. Sodding and seeding schedule(s) indicating anticipated dates and locations for work to be completed.

H. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.5 DELIVERY, STORAGE AND HANDLING

A. All sod must be delivered to the job within twenty-four hours after being cut. Sod shall not be permitted to dry out or not before installation.

B. Seed shall be delivered to the site in bags sealed by vendor, bearing bags tags for seed analysis and date of testing. Contractor shall keep all bag tags on file for the Engineer verification of seed type, quality, and quantity. All seed shall be stored in a manner which does not impair the quality and effectiveness of the seed.

C. Sod: Harvest, deliver, store and handle sod according to the requirements of the American Sod Producers Association's (ASPA) specifications for Turf Grass Sod Materials and Transplanting/Installing.

1.6 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until parties concerned mutually agree upon removal.

B. Excavation: When conditions detrimental to seeding and sod establishment are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before proceeding.

C. Finish grading shall be done in preparation for seeding. Any weed growth shall be removed prior to seeding.

1.7 GUARANTEE

A. General Guarantee: The Contractor shall guarantee the production of a close stand of the specified grass, acceptable to the Owner. All repairs, reseeding and resodding are to be done as part of the Contract and at no additional cost to Owner.

PART 2 – PRODUCTS

2.1 SODDING MATERIALS

A. Turfgrass Sod: Approved Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specification for Turfgrass Sod Materials" in its "Guideline Specification to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species shall match existing sod found on site unless none is present, in which case sod of grass species as follows, with not less than 95 percent germination not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
2. Sun and Partial Shade: Proportioned by weight as follows:
    a. 50 percent Kentucky bluegrass (Poa pratensis).
    b. 30 percent chewings red fescue (Festuca rubra variety).
    c. 10 percent perennial ryegrass (Lolium perenne).
    d. 10 percent redtop (Agrostis alba).
3. Shade: Proportioned by weight as follows:
    a. 50 percent chewings red fescue (Festuca rubra variety).
    b. 35 percent rough bluegrass (Poa trivialis).
    c. 15 percent redtop (Agrostis alba).

2.2 SEEDING MATERIALS

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.

B. Lawn Seed Species: Seed of grass species shall match existing grass found on site unless none is present, in which case seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
    1. Full Sun: Bermudagrass (Cynodon dactylon)
    2. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
    3. Sun and Partial Shade: Proportioned by weight as follows:
        a. 50 percent Kentucky bluegrass (Poa pratensis).
        b. 30 percent chewings red fescue (Festuca rubra variety).
        c. 10 percent perennial ryegrass (Lolium perenne).
        d. 10 percent redtop (Agrostis alba).
    4. Shade: Proportioned by weight as follows:
        a. 50 percent chewings red fescue (Festuca rubra variety).
        b. 35 percent rough bluegrass (Poa trivialis).
        c. 15 percent redtop (Agrostis alba).

C. Meadow Seed Species: Fresh clean, dry, new seed, mixed species as follows:
    1. 20 percent Fescue
    2. 15 percent Little Bluestem
    3. 15 percent Side Oats Gramma
    4. 10 percent Broom Sedge
    5. 10 percent Purple Prairie Clover
    6. 10 percent Annual Rye
    7. 10 percent Perennial Ryegrass
    8. 5 percent Orchard Grass
    9. 5 percent Timothy

D. Organic Compost:
    1. All ingredients shall be known and fully disclosed.
    2. Compost shall contain no human sludge or yard waste.
    3. At least 99% of all nitrogen in compost shall be in organic form.
    4. The Carbon: Nitrogen Ratio of the compost shall be less than 30:1 to eliminate Nitrogen starvation.

5. Compost shall have a pH level between 6.0 and 7.5.
6. Compost shall have moisture content no greater than 40%.
7. Compost shall be registered as a fertilizer in the state of Missouri.
8. Contractor shall submit an analysis and sample of the compost to the Owner's Representative for review and approval prior to installation.

E. Mulches:
1. Straw Mulch: Provide air-dried, clean, mildew and seed free, salt hay or threshed straw of wheat, rye, oats or barley.
2. Fiber Mulch: Biodegradable dyed-wood cellulose-fiber mulch, non- toxic, free of plant growth inhibitors or germination inhibitors, with maximum moisture content of 15 percent and a pH of 4.5 to 6.5.
3. Asphalt Emulsion Tackifier: Asphalt emulsion ASTM 0977, Grade SS-inhibitors.
4. Nonasphaltic Tackifier; Colloidal tackifier (Stay-Soil) recommended by fiber-mulch manufacturer for slurry application, non-toxic and free of plant growth inhibitors or germination inhibitors.

PART 3 – EXECUTION

3.1 PREPARATION

A. Sod Bed Preparation:
1. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1/2 inch in any dimension and other objects that may interfere with planting or maintenance operations.
2. Moisten prepared lawn areas before planting when soil is dry, Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

B. Seed Bed Preparation:
1. Repair any eroded areas and make minor grading adjustments to provide good drainage and to meet grade at all walks and paved surfaces.
2. Clean seed bed surface of all stones larger than 1/2 inch in diameter and all of existing vegetation, roots, brush, wire, grade stakes, and any other deleterious materials.
3. Using a rear tine tiller or other approved tiller uniformly combine a 2-inch layer of organic compost into existing soil. Drag lawn areas with approved equipment to insure a smooth surface to all lawn areas.
4. For areas that will be seeded, pre-treat existing lawn with herbicide and reapply to kill off remaining vegetation, if present, prior to seeding.

3.2 INSTALLATION

A. Sodding New Lawns:
1. Lay sod within 24 hours of stripping. Do not lay sod if dormant or if ground is frozen.
2. 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 sub-grade or sod during installation. Tamp and roll lightly to ensure contact with sub-grade, 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.
3. Lay sod across angle of slopes exceeding 3:1.

4. Anchor sod on slopes exceeding 6:1 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
5. Saturate sod with fine water spray within 2 hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below the sod.
6. Upon completion of the above work, the surface of the sodded areas shall coincide with the finished grade, shall be flush with other seeded or turfed areas, and shall meet the established grade adjacent to any paved areas. Care should be taken in sodding to preserve the finish grade elevations, so that there will be no depressions or uneven places in the surface of the sodded turf areas.

B. Seeding New Lawns:
   1. Apply seed mixture simultaneously with application of organic top dressing layer at a rate of 8 lbs. per 1,000 sf.
   2. Top dressing with seed shall be applied in a uniform 1/2 inch layer over lawn areas. In areas of existing lawns use a slit seeding method to apply appropriate seed mix.
   3. Keep organic top dressing and seed out of plant beds and off of walks, structures and areas not to be seeded.
   4. Protect seeded slopes exceeding 4:1 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.
   5. Protect seeded slopes exceeding 6:1 against erosion with jute or coil-fiber erosion control mesh installed and stapled according to manufacturer's recommendations.
   6. Protect seeded areas with slopes less than 6:1 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre to form a continuous blanket 1-1/2 inches loose depth over seeded areas. Spread by hand, blower or other suitable equipment.
      a. Anchor straw mulch by crimping into topsoil by suitable mechanical equipment.
      b. Anchor straw mulch by spraying with asphalt-emulsion tackifier at the rate of 10 to 13 gal. per 1000 sq.ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas.

C. Hydroseeding:
   1. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application
   2. Mix slurry with asphalt-emulsion tackifier.
   3. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch as a minimum rate of 1500-lb/acre dry weight but less than the rate required to obtain specified seed-sowing rate.

D. Reseeding:
   1. Bare Patches or washouts due to heavy rains, prior to establishment and acceptance of the new turf, shall be regraded as needed, reseeded and watered, as often as necessary at Contractor’s expense.

3.3 LAWN MAINTENANCE

A. The maintenance of the lawns shall begin immediately after seeding and sodding and continue until Final Acceptance, but not less than 30 calendar days. The sodded turf area shall be watered daily for the next 10 days after installation to keep soil moist. Then reduce watering to 2 to 3 days per week until turf is well established. Any sod not surviving the first month shall be replaced with new sod from the same source.

B. The maintenance of the seeded turf shall be the Contractor's responsibility until the new grass is 4 inches high and thick enough to receive its first mowing by the Owner and for a minimum of 30 days. The Contractor shall protect and restore seeded areas by watering, fertilizing, removing weeds, and reseeding as necessary, to ensure a uniform stand of established grass until Final Acceptance of the seed lawn by the Owner's Representative.

C. Mowing of sod lawn is the responsibility of the Contractor until Final Acceptance. The first mowing will not be attempted until the lawn is 4 inches high and thick enough to receive its first mowing. Mow to a height of 3" returning clippings to the lawn. Never mow off more than 1/3 of the grass leaves.

D. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

E. Use fertilizer that will provide actual nitrogen of at least 1 lb. per 1,000 sq. ft. to lawn areas.

3.4 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of Contractor’s warranty period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Satisfactory Sodded Lawns: At end of Contractor’s warranty period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

C. Reestablish lawns that do not comply with the above requirements and continue to maintenance until lawns are satisfactory.

3.5 PROTECTTION

A. Protection of seeded and sodded areas shall begin immediately after the Contractor completes the seeding and sodding work. Contractor shall protect newly graded, seeded and sodded areas from erosion, damage due to landscaping operations, operations by other contractors and trades and trespassers. Contractor shall repair all damaged areas prior to final acceptance.

END OF SECTION 329200

SECTION 33 05 26
UTILITY IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Detectable Warning Tape for placement above direct-buried utility.
   2. Trace wire for placement above direct-buried utility.
   3. Utility Markers.

B. Related Requirements:

   1. Section 331000 - Water Utility Distribution - Piping, valves and appurtenances requiring identification marking.
   2. Section 333100 - Sewer Utility Sewerage Piping - Piping requiring identification marking.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information for each product required.

B. Samples: Submit 10 feet of ribbon tape and 10 feet of trace wire.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Qualifications Statement:

   1. Submit qualifications for manufacturer.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves.

1.4 QUALITY ASSURANCE

A. Perform Work according to local jurisdiction standards.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 DETECTABLE WARNING TAPE

A. Manufacturers:

1. Berntsen International Inc., Brimar Industries Inc., or approved equal.
2. Substitutions: As specified in Division 01- Product Requirements.

B. Description:

1. Material: Acid and alkali resistant polyethylene.
2. Brightly colored, as follows:

    a. Red: Electric.
    b. Yellow: Gas, oil, steam, and dangerous materials.
    c. Orange: Telephone and other communications.
    d. Blue: Water systems.
    e. Green: Sewer systems.

3. Minimum Size: 6 inches wide by 4 mils thick.
4. Manufactured for direct burial service.
5. Continuously inscribed with description of utility.
6. Detectable by metal detector when tape is buried up to 30 inches deep.

2.2 TRACE WIRE

A. Manufacturers:

1. Northtown Company, Priority Wire and Cable, TracerWire, or approved equal.
2. Substitutions: As specified in Division 01 - Product Requirements.
3. Description:

    a. Wire: Shall be #12 TW solid, coated copper wire.
    b. Connections: Shall be done with wire nuts or split-bolts.

2.3 UTILITY MARKERS

A. Manufacturers:

1. Berntsen International Inc., Brimar Industries Inc., or approved equal.
2. Substitutions: As specified in Division 01 - Product Requirements.

B. Metal:

1. Material: Bronze.
2. Diameter: 2 inches.
3. Stem: ¾ by 2 inches.
4. Text: “Warning: Utility Buried Below”

C. Plastic:

1. Material: Plastic.
2. Type: Post.
3. Diameter: 2 inches.
4. Text: “Warning: Utility Buried Below”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Detectable Warning Tape:

1. Continuous buried 12 inches above pipe.
2. If multiple pipes occur in common trench, locate tape above centerline of trench.
3. Coordinate with trench work as specified in Division 02 Site Preparation and Earthwork.

B. Trace Wire:

1. Utilize approved trace wire connection materials. Cover all exposed copper with approved heat shrink sleeves or electrical tape.
2. Install the trace wire on top of main and secure to main every five (5) feet with tape.
3. Bring trace wire to the surface at a maximum spacing of one thousand (1,000) feet.
4. Approved methods to bring trace wire to the surface:

    a. Trace wire in a vault.

        1) When using a vault, bring trace wire to the surface on the outside of the vault, through hole into the inside of the vault, and coil enough wire to extend a foot above ground. Do not wrap around steps inside of vault.

    b. Trace wire in a blue plastic marker.

        1) Bury a 4 foot u-channel post 2 feet in the ground. Run the trace wire up through the marker and slide the blue plastic marker over the post. Bury the bottom 6 inches of the marker. Connect the trace wire to brass connecting screws located on the marker, and label the screws showing direction of trace wire at each screw. Note location of trace wire marker on as-built drawing.

    c. Trace wire in a test box adjacent to a valve box.

        1) Install the trace wire in a test box about a foot from the valve box. Make sure there is enough wire to extend a foot above ground. Paint the lid blue. Note location of test box on as-built drawing.

    d. Trace wire in a valve box top section.

        1) When trace wire is to be brought to the surface in an area where a marker is not practical, a valve box top section may be used. Coil enough wire to extend a foot above ground. Fill with sand to a foot from the top. Spray paint the lid blue. Note location of trace wire box on as-built drawings.

C. Utility Markers: As recommended by manufacturer.

END OF SECTION 330526

SECTION 33 10 00
WATER UTILITY DISTRIBUTION

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: requirements and specifications necessary to install the water distribution system as shown on the project drawings.

B. Testing and disinfection of the installed system is incidental to the work.

C. Provide construction staking in accordance with generally accepted practice for layout of underground utilities.

D. The work includes coordination with building plumbing contractors and building plumbing plans.

E. Coordinate responsibilities for installation of meters, vaults, check valves, backflow preventers, taps, valves and appurtenances with the local jurisdiction.

F. Fees related to water meter installation, whether tap, meter or other fees will be paid by the Contractor. Identify fees for installation of water services and provide written report to the Owner.

G. Connections between the new construction and existing mains may be made by the Local Jurisdiction. Water service may be brought to the property line by the Local Jurisdiction. Contractor shall verify the extent to Local Jurisdiction work and coordinate the work with the work of the Local Jurisdiction.

1.2 GENERAL CONDITIONS

A. Coordinate installation of the water distribution system with grading and paving operations.

B. Provide water mains when grade is within 6 inches of final grade and prior to paving base installation.

C. After completion and testing of the water distribution system, provide the Owner with the Contractor's Material and Test Certificates required by the National Fire Protection Association.

1.3 QUALITY ASSURANCE

A. Meet the requirements of the local jurisdiction. Where a conflict exists between this specification and the local County, City, or State specification, meet the more stringent specification.

1.4 SUBMITTALS

A. Product Data for the following:
    1. Pipe and Fittings
    2. Valves, Meters, other accessories.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves 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 flanged faces.
    3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves 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 whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve 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 piping to prevent sagging and bending.

PART 2 – PRODUCTS

2.1 PIPE

A. Ductile Iron or PVC pipe for diameters four (4) inches and larger:

    1. Designate, manufacture, and test ductile iron pipe in accordance with ANSI A21.51, A21.4 and AWWA C-151. Conform outside diameters to A21.50, Class 150 Standards for each size pipe. Wall thickness for each pipe not less than that specified under A21.50 for thickness Class 50 in accordance with AWWA C-104.
    2. Use approved ductile iron pipe push-on joints conforming to AWWA C-111.
    3. PVC may be installed where permitted by local jurisdiction:

a. For domestic potable water service, meet ASTM D 2241 PVC SDR 21 Class 200.
b. For fire protection systems, meet AWWA C900, rubber gasket joints, DR14, Class 200.

B. PVC pipe for diameters smaller than four (4) inches:

1. Conforming to ASTM D 1785 PVC Schedule 80

2.2 WATER PIPE FITTINGS

A. Ductile irons fittings meeting AWWA C-153, for water pipes four (4) inches or larger. Use mechanical joint fittings, complete with joint accessories, for the class and type of pipe with which they are used. Use cement-lined fittings with the inside and outside bituminous-coated. Mark fittings with class and weight.

B. PVC fittings conforming to ASTM D 2467 for PVC plastic fittings, schedule 80.

2.3 VALVES AND BOXES

A. For valves larger than 2 inches, use cast iron gate valves, AWWA C500 or C509, metal or resilient seated, made by a recognized valve manufacturer: Mueller, Iowa, M&H or approved equal. Use valves constructed of an interchangeable parts system, with parts readily available, and meet the following requirements:

1. Iron body bronze-mounted
2. Double disc, parallel seat "0" ring seal, or resilient seat seals
3. 150 psi minimum working pressure
4. Counterclockwise (left) opening
5. 2-inch operating nut
6. Non-rising stem
7. Joints as required for connection to main

B. For valves up to and including 2 inches, use Bronze Body, Bronze Trim, Rising Stem, Inside Screw, Single Wedge or Disc.

C. Provide underground valves in standard cast iron valve boxes. Use boxes of the two-piece screw type, adjustable to suit the depth of bury and type of valve, with a minimum shaft diameter of 5 1/4 inches. Provide one operating wrench for each ten valves, or fraction thereof.

2.4 FIRE HYDRANTS

A. Use fire hydrants of the most recent AWWA type of construction with a minimum valve opening of 4 1/4 inches. Meet the requirements of AWWA Specification C-502, and equip as follows: Two hose nozzles - 2 ½ inches; one pumper nozzle - 4 ½ inches, Packing - "O" ring; groundline to centerline hose nozzles - 18 inches; groundline to bottom of connection pipe - 48 inches unless otherwise approved. Use operating nut size rotation, and nozzle threads to match Local Jurisdiction Standards. Use traffic model hydrants, utilizing a breakable feature at the groundline consisting of a flange of breakable bolts, and

safety stem coupling. Hydrants of the "wet-top" type will not be acceptable. Use hydrants by Mueller, American Darling, M&H, Kennedy, or approved equal.

B. Use hydrants shop-painted above the ground line. After installation, field paint hydrants to match Local Jurisdiction Specifications.

C. Use hydrants with mechanical joints with tie rods and blocking of the line tee.

2.5 WATER METERS

A. Use commercial standard water meters of the size and capacity to meet the design flow condition.

B. Conform to the requirements of Local Jurisdiction.

2.6 BACKFLOW PREVENTERS AND DOUBLE DETECTOR CHECK VALVES

A. Use Commercial Standard Backflow Preventers and Double Detector Check Valves of the size and capacity to meet the design flow condition.

B. Conform to the requirements of the local jurisdiction.

C. Manufacturers: As required by the local jurisdiction; If not locally specified, WATTS, NEPTUNE, or equal.

2.7 THUST BLOCKING

A. Use pipe restrained by concrete thrust blocking as shown on the project drawings, in the event of the following pipe conditions:

1. A change in direction with the use of a tee or bend.
2. Reduction in the size of the line by use of a reducer.
3. Termination of line (dead end).

2.8 DETECTION TAPE

A. Lay metallic detection tape where PVC pipe is installed atop the pipe in the trench no less than 18 inches and no more than 24 inches below finish grade.

B. Meet pipe manufacturer’s specifications.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General

1. Line and Grade: Lay and maintain pipe to the required lines and grades with fittings, valves, and hydrants at the required locations and with joints centered and spigots hung with valve and hydrant stems plumb.

2. Protecting Underground and Surface Structures: Provide, at the Contractor's expense, temporary support, adequate protection and maintenance of underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work.

3. Sub-Surface Exploration: Whenever necessary to determine the location of existing pipes, valves, or other underground structure, examine available records and make explorations and excavations.

B. Laying Pipe

1. Trench excavation shall be done in conformance with Section 31 23 00 Excavation and Fill, Article 3.6 Excavations for Utility Trenches.

2. Before lowering pipe into trenches, install bedding material so that when pipe is in the ditch, it will have a bearing for its entire length. Carefully examine the pipe for defects and clean the inside.

3. After placing pipe into ditch, wipe free of dirt, sand and foreign material the bell, gasket, and spigot. Apply to the gasket and spigot a film of lubricant. Enter the plain ends of the pipe into the socket and force the pipe into the socket until it makes contact with the bottom of the socket.

4. At times when pipe laying is not in progress, plug the open ends of the pipe by approved means and so no trench water enters the pipe.

5. Cutting Pipe: Perform cutting of pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damage to the pipe, using approved mechanical cutters.

6. Direction of Laying: Unless otherwise directed, lay pipe with bell ends facing in the direction of laying. For lines on an appreciable slope, bells face upgrade.

7. Permissible Deflection: Whenever necessary to deflect pipe from a straight line either in the vertical or the horizontal plane to avoid obstruction, to plumb stems, or where long radius curves are permitted, use the degree of deflection recommended by the manufacturer of the pipe.

C. Bedding and Backfilling

1. Bedding and Backfilling operations and materials shall conform the project drawings and Section 31 23 00 Excavation and Fill, Article 3.11 Utility Trench Backfill.

D. Mechanical Joints

1. Thoroughly bolt mechanical joints in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength low-alloy steel having a minimum yield point strength of 40,000 pounds per square inch, and an

ultimate tensile strength of 70,000 pounds per square inch. Use gaskets and bolts and nuts that conform to ANSI A21.11. Use glands of high strength cast iron.

2. Installation:
    a. The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and adequate anchorage be provided where abrupt changes in direction and dead ends occur.
    b. Brush the surfaces with which the rubber gasket comes in contact thoroughly with a wire brush just prior to assembly to remove loose rust or foreign material and to provide clean surfaces brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell. Brush soapy water over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
    c. Tighten joint bolts using approved wrenches to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange around the socket. Partially tighten the bottom bolt first, then the top bolt, next the bolts at either side, and finally, the remaining bolts. Repeat this cycle until bolts are within the above ranges and torques. If effective sealing is not attained at the maximum torque indicated, disassemble and re-assemble the joint after thorough cleaning. Overstressing of bolts to compensate for poor installation is not permitted.

E. Setting Appurtenances

1. Valves and Fittings: Set and joint gate valves and pipe fittings to new pipe in the manner previously specified for cleaning, laying, and jointing pipe.
2. Valve Boxes: Support, maintain center and plumb over the wrench nut of the gate valve with box cover flush with the surface of the finished pavement.
3. Water Meters, Backflow Preventers, Double Detector Check Valves, Vaults, etc.: Field adjust vault locations to fit into assigned vault areas, set vaults plumb and level, drain vaults as needed, leave no standing water in vaults. Seal wall openings around pipes with flexible sealant and grout to allow for pipe movement and vault settlement. Provide traffic grade top slabs, accessways, and appurtenances where vaults are located in vehicular areas. Provide clearance around valves and flanges to allow for disassembly of piping and equipment.

F. Setting Hydrants

1. General Locations: Locate hydrants in a manner to provide complete accessibility so that the possibility of damage from vehicles or injury to pedestrians is minimized.
2. Position of Nozzles: Use hydrants standing plumb and having pumper nozzles at an angle of 90 degrees in respect to the curb. Use hydrants that have their nozzles located at the height above finished grade required by the Local Jurisdiction, but not less than 12 inches.

3. Drainage at Hydrants: Wherever hydrants are set in impervious soil, excavate a drainage pit below each hydrant, fill and compact with coarse gravel or broken stone mixed with coarse sand under and around the bowl of the hydrant and to a level of 6 inches above the waste opening as shown on the drawings.
4. Cleaning: Thoroughly clean hydrants of dirt and foreign matter before setting.

G. Anchorage of Bends, Tees, and Plugs

1. Limiting Pipe Diameter and Degree of Bend: Apply reaction or thrust blocking on pipelines at tees, plugs, caps, and at bends deflecting 11 degrees or more, or prevent movement by attaching suitable metal rods or straps.
2. Material for Reaction Blocking: Use reaction or thrust blocking of concrete. Place blocking between solid ground and the fitting to be anchored; the area of bearing on pipe and on ground in each instance as shown on the drawings. Place the blocking so that the pipe and fitting joints are accessible for repair.

3.2 TESTING AND DISINFECTION

A. Hydrostatic Tests

1. Pressure During Tests: After the pipe has been laid and partially backfilled, test newly laid pipe or any other valved section of it, unless otherwise directed. Subject to a minimum hydrostatic pressure of 200 psi or 50 psi above the inlet static pressure if the inlet pressure exceeds 150 psi.

2. Duration of Pressure Tests: At least 2 hours.

3. Procedure: Conform to NFPA 24 and AWWA C600. Slowly fill each section of pipe with water and measure the specified test pressure measured at the lowest point elevation by means of a pump connected to the pipe in a satisfactory manner. Provide the pump, pipe connection, gauges, and necessary apparatus. Apply the tests to each valved section in order to check the leakage through valves.

4. Expelling Air Before Test: Before applying the specified test pressure, expel air from the pipe. Make taps, if necessary, at points of highest election and afterward tightly plug.

5. Leakage Defined: Leakage is defined as the quantity of water to be supplied into the newly laid pipe or any valved section of it necessary to maintain the specified leakage test pressure after the pipe has been filled with water and air expelled.

6. Permissible Leakage: Provide suitable means for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless the leakage is less than two (2) quarts per hour per 100 gaskets or joints irrespective of pipe diameter.

7. Variation from Permissible Leakage: When any test of combined sections of pipe laid disclose leakage per mile of pipe greater than that specified, or if individual

sections show leakages greater than the specified limit, locate and repair the defective joint until the leakage is within the specified allowance at no cost to the Owner.

8. Time for Making Tests: Subject pipe to hydrostatic pressure, inspect, and test for leakage at any convenient time after partial completion of backfilling. Truck water as necessary to make the test when each section is ready.

B. Sterilization

1. Sterilize in accordance with AWWA C601. Sterilize by the application of clear water containing a minimum of 50 ppm of available chlorine. Keep the chlorine bearing water in contact with the surfaces being sterilized for a period of not less than 24 hours. At the end of the contact period, maintain the chlorine residual in units and at extremities of pipelines at a minimum concentration of 25 ppm.

2. Chlorinating Valves and Hydrants: Operate valves and other appurtenances while the pipeline is filled with the chlorinated agent.

3. Final Flushing and Test: Following chlorination, thoroughly flush treated water from the newly laid pipeline at its extremities until the replacement water throughout its length, upon test, meets the requirements of the Local Jurisdiction. Arrange for test samples.

4. Repetition of Procedures: If the initial treatment prove ineffective, repeat the chlorinating procedure until confirmed tests show that water sampled conforms to the requirements previously stated.

C. Alternate Testing and Sterilization

1. Alternate or additional testing and sterilization methods may be requested by the Local Jurisdiction. Deviations from these methods may be employed with permission of the Local Jurisdiction.

END OF SECTION 331000

SECTION 33 31 00
SEWER UTILITY SEWERAGE PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: requirements and specifications necessary to install the sanitary sewer piping, valves, and other accessories, excluding manholes, as shown on the project drawings.

B. Testing of the installed system is incidental to the work.

C. Provide construction staking in accordance with generally accepted practice for layout of underground utilities.

D. The work includes coordination with building plumbing contractors and building plumbing plans.

E. Fees related to sewer service installation, whether tap, meter or other fees will be paid by the Contractor. Identify fees for installation of sewer services and provide written report to the Owner.

F. Connections between the new construction and existing mains may be made by the Local Jurisdiction. Sewer service may be brought to the property line by the Local Jurisdiction. Contractor shall verify the extent to Local Jurisdiction work and coordinate the work with the work of the Local Jurisdiction.

1.2 RELATED SECTIONS

A. Section 312300 Excavation and Fill for trenching, bedding, and backfill requirements.

B. Section 333900 Sanitary Utility Sewerage Structures for manhole requirements.

1.3 GENERAL CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do no 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. Notify property owner not less than two days in advance of proposed utility interruptions.

1.4 SUBMITTALS

A. Product Data for the following:

1. Pipe and Fittings
2. Valves and cleanouts.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves 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 flanged faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves 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 whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve 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 piping to prevent sagging and bending.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 “Piping Applications” Article for applications of pipe and fittings materials.

2.2 PIPE AND FITTINGS

A. Ductile Iron Pressure Pipe: AWWA C151.

   1. Standard-Pattern, Ductile Iron Fittings: AWWA C110, ductile or gray iron, buried or flooded pipe shall have mechanical joints, interior or exposed pipe shall be flanged unless otherwise indicated or specified.
   2. Gaskets: AWWA C111, Rubber.

3. Flanges: Ductile Iron, conforming to ANSI B16.1 and shall be drilled class 125.
4. Flange Bolts: Bolts shall conform to ASTM A307 Grade B.
5. Flange Gaskets: Shall be 1/8" thick, full-faced synthetic rubber.

B. Ductile Iron Gravity Sewer Pipe: ASTM A 746, for push-on joints.

1. Standard-Pattern, Ductile Iron Fittings: AWWA C110, ductile or gray iron, for push-on joints.
2. Gaskets: AWWA C111, Rubber.

C. PVC Pressure Pipe: AWWA C900, Class 200 or ASTM 2241, 200 psi, SDR 21, for gasketed joints.

1. Ductile Iron, Compact Fittings: AWWA C153, for push-on joints.
2. Gaskets for Ductile Iron Fittings: AWWA C111, Rubber.

D. PVC Gravity Sewer Pipe and Fittings: As specified on project drawings and according to the following:

1. SDR 35 and SDR 21 PVC Sewer Pipe and Fittings: ASTM D 3034, gasketed joints. Gaskets are to conform to ASTM F 477, elastomeric seals.
2. Schedule 40 and Schedule 80 PVC Sewer Pipe and Fittings: ASTM D 3034. Solvent-cemented joints. Solvent Cements are to conform to ASTM D 2564 and ASTM D 2855.

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to mate with OD of pipes to be joined, for non-pressure joints.

1. Sleeve material for cast-iron soil pipe: ASTM C 564, rubber.
2. Sleeve material for plastic pipe: ASTM F 477, elastomeric seal.
3. Sleeve material for dissimilar pipe: Compatible with pipe materials being joined.
4. Bands: Stainless steel, at least one at each pipe insert.

B. Bushing-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric bushing fabricated to mate with OD of smaller pipe and ID of adjoining larger pipe for non-pressure joints.

1. Material for cast-iron soil pipe: ASTM C 564, rubber.
2. Material for plastic pipe: ASTM F 477, elastomeric seal.
3. Sleeve material for dissimilar pipe: Compatible with pipe materials being joined.

C. Pressure-Type Pipe Couplings: AWWA C 219, iron-body sleeve assembly matching OD of pipes to be joined, with AWWA C 111 rubber gaskets, bolts, and nuts. Include PE film, pipe encasement.

D. Ductile Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical joint ends complying with AWWA C 110 or AWWA C 153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated. Include PE film, pipe encasement.

E. Ductile Iron, Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C 110 or AWWA C 153. Include rating for 250-psig minimum working pressure and for up to 15 degrees deflection. Include PE film, pipe encasement.

F. Ductile Iron, Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile iron, bell-and-spigot end sections complying with AWWA C 110 or AWWA C 153. Include rating for 250-psig minimum working pressure and for expansion indicated. Include PE film, pipe encasement.

2.4 VALVES AND ACCESSORIES

A. Non-rising Stem, Resilient-Seated Gate Valves, 3 inch NPS and larger: AWWA C 509, gray or ductile iron body and bonnet; with bronze or gray or ductile iron gate, resilient seats, bronze stem, and stem nut. Include 200-psig minimum working pressure design, interior coating according to AWWA C 550, and buried valves shall be mechanical-joint with a 2 inch operating nut, exposed or interior valves shall have flanged ends and have hand wheel operators. Valves shall open counter clockwise. Valve stems shall use double “O” ring seals.

B. Check Valves: AWWA C 508, with 175-psig working pressure rating. Include interior coating according to AWWA C 550. Valve hinge pins shall be stainless steel. Valve disc shall be full opening with a composition to metal seal. Valve shall be flanged unless noted otherwise on the project drawings. Valves shall be equipped with an external lever that is spring assisted. The spring tension shall be field adjustable by a hex nut. The lever arm shall be keyed to the valve hinge shaft.

C. Check Valves – Cushioned: AWWA C 508, with 175-psig working pressure rating, with addition of exterior cushion chamber. Include interior coating according to AWWA C 550. Swing disc type with stainless steel shaft and flanged body. Flanges shall be ANSI B16.1, Class 125. Valve disc shall be external lever and adjustable counterweight to initiate closure. Valves shall be a metal to composition seat.

D. Eccentric Plug Valves:

1. Plug valves shall be quarter-turn non-lubricated eccentric type with resilient faced plug. Alternate seat and plug materials may be considered provided the specification is met and, in addition, the manufacturer must prove prior to approval that the valve meets AWWA C 504 “proof of design tests” (10,000 cycles) in both directions. Flanged valve ends shall be faced and drilled to conform to ANSI B16.1, Class 150 for diameter and drilling. Mechanical or push-on type rubber-gasketed joint ends shall conform to AWWA C 111. Port areas for valves smaller than 20-inch shall be at least 80 percent of full pipe area. Port areas for valves 24-inch and larger shall be at least 70 percent of full pipe area.
2. Materials and Construction:
    a. Bodies shall be of ASTM A 136, Class B cast iron.
    b. Valve plug shall be ASTM A 126, Class B cast iron or ASTM A 536 ductile iron. Resilient plug facing shall be synthetic rubber, neoprene or Buna N compound suitable for use with water and wastewater applications.
    c. Seats shall be a raised welded overlay of 90 percent pure nickel, a minimum of 0.125 inch thick and 0.50 inch wide, conforming to AWWA C 504. When the plug is in the closed position, the resilient plug facing shall contact only nickel. Sprayed or plated mating seat surfaces are not acceptable for resilient plugs.
    d. Bearings shall be replaceable. Sleeve bearings in the upper and lower journals shall be permanently lubricated 316 stainless steel per ASTM A 743 Grade CF-8M. Nonmetallic journal bearings shall not be acceptable. Thrust bearings shall be Teflon.

e. Shaft seals shall be self-adjusting chevron-type conforming to AWWA C 504. Valve shall be designed so it can be repacked while the valve is in line and under pressure without removing the actuator. O-ring seals shall not be acceptable in vales larger than 3 inches.
f. All exposed fastened hardware shall be zinc plated or stainless steel. Provide stainless steel bolting on buried service valves.

3. Manual Operators:
   a. All valves shall open counterclockwise.
   b. Provide indicators to show position of plug except on buried operators.
   c. Actuators: manual valves shall have lever or worm gear actuators with handwheels, chainwheels, tee wrenches, extension stems, floorstands, etc., as shown on the plans or as called for in the valve schedule. Lever actuators shall be furnished for valves 8 inches or smaller where the maximum shutoff pressure is 25 psi or less as indicated on the plans or in the valve schedule. Worm gear actuators shall be furnished for all valves 4 inches or larger where the maximum reverse shutoff pressure is greater than 25 psi. Worm gear actuators shall be sized for 150 psi. all gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. This adjustable stop shall be the only adjustment necessary to set the clearance between the valve plug and the seat while the valve is in line and under pressure. Handwheel and chainwheel sized for worm gear actuators shall be no smaller than 6 inches in diameter and no larger than twice the diameter of the actuator's gear sector. All exposed nuts, bolts, and washers shall be zinc plated. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator convers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gaskets seals. All exposed nuts, bolts, springs, and washers shall be stainless steel.
   d. Handwheels shall be located for easy access on exposed valves.
   e. Buried valves shall be operated by a 2 inch AWWA nut with valve box.
4. Testing: Furnish certified copies of results of tests prior to shipment. All valves shall be subjected to an AWWA C 504 procedure leak test at 150 psi against the face of the plug and a body hydrostatic test at 300 psi. Valves shall be capable of providing drip-tight shutoff up to the full leak test rating with pressure in either direction.

E. Ball Valves (Polymer Service and Non-Potable Water 2 inch and smaller):

1. Ball valves shall be PVC true union with either solvent socket or threaded pipe connections. Pressure rating shall exceed 230 psi.
2. Seats shall be PTFE with backing rings. Backing rings and seals shall be Ethylene-propylene-diene-monomer rubber (EPDM).
3. PVC shall meet or exceed cell classification 12454B, ASTM D 1784.
4. Socket end connections shall conform to ASTM D 2467. Threaded pipe connections shall conform to ANSI B2.1.
5. Exposed valves shall be operated by a 2 inch AWWA nut. Valve shall not be buried.

F. Backwater Valves:

1. Gray-Iron Backwater Valves: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
    a. Horizontal Type: With swing check valve and hub-and-spigot ends.
    b. Combination Horizontal and Manual Gate-Valve Type: With swing check valve, integral gate valve, and hub-and-spigot ends.
    c. Terminal Type: With bronze seat, swing check valve, and hub inlet.
2. PVC Backwater Valves: Similar to ASME A112.14.1, horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

G. Air Release Valves: Shall be A.R.I. model D-025 combination air valve for sewage.

H. Appurtenances:

1. Trace Wire: Magnetic detectible conductor (#12 copper).

2.5 POLYETHYLENE PLASTIC (PE) FILM, PIPE ENCASEMENT

A. ASTM A 674 or AWWA C 105; PE film, tube, or sheet, 8-mil thickness.

2.6 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.
2. Medium Duty: In paved foot-traffic areas.
3. Heavy Duty: In vehicle-traffic service areas.
4. Extra-Heavy Duty: In roads.
5. Sewer Piping Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.7 DETECTABLE WARNING TAPE

A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum six (6) inches wide and four (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 green for sewer systems.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on the project drawings.

3.2 EARTHWORK

A. Excavation, trenching, bedding, and backfilling are specified in Section 31 23 00 Excavation and Fill.

B. Hand trim excavations to required elevations. Correct over excavation with bedding material.

C. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.

3.3 IDENTIFICATION

A. Install detectable warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.4 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for piping and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: As indicated on the project drawings:

1. NPS 4 and NPS 6: PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints. (4 inch pipe is allowed on gravity service laterals from building to main only. All gravity sewer mains must be a minimum of 6 inches in diameter).
2. NPS 8 and NPS 10: PVC sewer pipe and fittings, or gaskets and gasketed joints.
3. NPS 12 and NPS 15: PVC sewer pipe and fittings, or gaskets and gasketed joints.

D. Force-Main Piping: As indicated on the project drawings:

1. NPS 4 to NPS 8: Ductile Iron sewer pipe; standard or compact-pattern, ductile iron fittings; gaskets; and gasketed joints.
2. NPS 4 to NPS 8: PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.

3.5 SPECIAL PIPE AND COUPLING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for non-pressure applications:
    a. Sleeve type to join piping, of same size, or with small difference in OD.
    b. Increase/reducer-pattern, sleeve type to join piping of different sizes.
    c. Bushing type to join 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. Include PE film, pipe encasement.

B. Special Pipe Fittings: Use where indicated. Include PE film, pipe encasement.

3.6 INSTALLATION, GENERAL

A. General Locations and Arrangements: Project drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated.

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 using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use 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.

D. Molded Tees shall be used for all "tee" connections for new construction of gravity sewers. Inserta-Tees® (or approved equal) shall be used on all tap connections to existing gravity sewer pipes.

E. Install ductile iron, force main piping according to AWWA C 600.

F. Install PVC force main piping according to AWWA M 23.

G. Location of Sewers with respect to Water Mains:

1. Horizontal Separation: Whenever possible, any sanitary sewer shall be laid at least 10 feet, horizontally, from a water main. When local conditions prevent a separation of 10 feet, the Missouri Department of Natural Resources (MoDNR) may allow a sanitary sewer to be laid closer than 10 feet to a water main provided that the sanitary sewer is laid at least 18 inches below the bottom of the water main. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer must be constructed of mechanical or slip-on joint ductile iron pipe and should be pressure tested to assure watertightness before backfilling. Both of these alternatives must be specifically approved by MoDNR on a case-by-case basis.

2. Vertical Separation: Whenever sanitary sewers must cross water mains, the sewer shall be laid at such an elevation that the bottom of the water main is no closer than 18 inches above the top of the sewer. The vertical separation shall be maintained for that portion of the sanitary sewer located within 10 feet, horizontally, of any water main it crosses. The crossing shall be arranged so that the sewer joints will be equal distance and as far as possible from the water main joints.

3. Unusual Conditions: Where conditions prevent the minimum vertical separation set forth above from being maintained, or when it is necessary for the sewer line to pass over a water main, the sewer line shall be laid with slip-on mechanical joint ductile iron pipe, and the sewer line shall extend on each side of the crossing a distance from the water main of at least 10 feet. In making such a crossing, a full length of ductile iron pipe must be centered over or under the water main to be crossed so that the joints will be equidistant from the water main and as remote therefore as possible. The water main must also be constructed of ductile iron pipe with slip-on or mechanical joints until the nominal distance from the sewer line to the water main is at least 10 feet. Where a water main must cross under a sewer, a vertical separation of 18 inches between the bottom of the sewer and the top of the water main shall be maintained, with adequate support, especially for the larger sized sewer lines, to prevent them from settling on and breaking the water main. The sewer shall be constructed of ductile iron pipe for a distance of 10 feet on either side of the crossing, or other suitable protection as approved by the MoDNR.

H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

I. All gravity sewer lines shall be installed with minimum slopes according to the following table:

Sewer Size	Minimum Slope (feet per 100 feet)
6 in.	0.60
8 in.	0.40
9 in.	0.33
10 in.	0.28
12 in.	0.22
14 in.	0.17
15 in.	0.15
16 in.	0.14
18 in.	0.12
21 in.	0.10
24 in.	0.08
27 in.	0.067
30 in.	0.058
36 in.	0.046

3.7 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Ductile Iron Sewer Pipe with Ductile Iron Fittings: According to AWWA C 600. Install PE film, pipe encasement over ductile iron sewer pipe and ductile iron fittings according to ASTM A 674 or AWWA C 105.

C. PVC Pressure Pipe and Fittings: Join and install according to AWWA M 23.

D. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.

E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

G. Install with top surfaces of components, except piping, flush with finished surface.

3.8 REACTION ANCHORAGE AND BLOCKING

A. All unplugged bell and spigot or all-bell tees, Y-branches and bends deflecting 11-1/4 degrees or more with are installed in piping subject to internal hydrostatic heads in excess of 15 feet in exposed, or 30 feet in buried applications, shall be provided with suitable reaction blocking, struts, anchors, clamps, joint harness, or other adequate means for preventing movement of the pipe cause by unbalanced internal liquid pressure.

B. Trench Installation: Where in trench, the forgoing designated fittings shall be provided with concrete thrust blocking between the fitting and solid, undisturbed ground in each case, except where solid ground blocking support is not available. At the tops of slopes vertical angle bends shall be anchored by means of steel strap or rod anchors securely embedded in or attached to a mass of concrete of sufficient weight to resist the hydraulic thrust at the maximum pressures to which the pipe will be subjected. All concrete blocking and anchors shall be installed in such a manner that all joints between pipe and fittings are accessible for repair.

C. The bearing area of concrete reaction blocking against the ground or trench bank shall be as shown by the plans or as directed be the Engineer in each case. In the even that adequate support against undisturbed ground cannot be obtained, metal harness anchorages consisting of steel rods or bolts across the joint and securely anchored to pipe and fittings or other adequate anchorage facilities approved by the Engineer shall be installed to provide the necessary support. Should the lack of a solid vertical excavation face be due to careless or otherwise improper trench excavation, the entire cost of furnishing and installing metal harness anchorages in excess of the contract value of the concrete blocking replaced by such anchorages shall be borne by the Contractor.

D. For other locations: Reaction blocking, struts, anchorages, or other supports for fittings installed in fills or other unstable ground, above grade, or exposed within structures, shall be provided as required by the project drawings or as directed by the Engineer.

E. Protection of meal surfaces: All steel clamps, rods, bolts and other metal accessories used in reaction anchorages or joint harness subject to submergence or contact with earth or other fill material and not encased in concrete shall be adequately protected from corrosion with not less than two coats of Koppers “Bitumastic No. 50”, or approved equal, heavy coal tar coating material, applied to clean, dry metal surfaces. The first coat shall be dry and hard before the second coat is applied. Metal surfaces exposed above grade or within structure shall be painted with two coats (in addition to a primer coat) of paint approved by the Engineer.

F. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.9 BACKWATER VALVE INSTALLATION

A. Install horizontal units in piping where indicated.

B. Install combination units in piping and in structures where indicated.

3.10 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Install piping so cleanouts open in direction of flow of sewer.

B. Set cleanout frames and covers in earth, set with tops a minimum of one (1) inch above surrounding grade.

C. Set cleanout frames and covers in pavement flush with pavement surface.

3.11 AIR RELEASE FACILITIES

A. Air release valves shall be A.R.I. model D-025 combination air valve for sewage.

B. Air release facilities shall be located at the high points of all pressure sewer systems and shall be properly sized to prevent buildup of air or gasses that will impede flow of the wastewater.

C. Air release valves must be automatic and designed to prevent wastewater solids and grease from reaching the valve operating mechanism.

D. Provisions for cleaning the valve by back flushing should be provided.

3.12 TAP CONNECTIONS

A. Tap connections to existing sanitary sewer mains shall be made in accordance with the Local Jurisdiction’s requirements and specifications. It is the Contractor’s responsibility to coordinate tap connections with the Local Jurisdiction and to verify that local requirements and specifications are followed. If no such specifications exist, tap connections shall be made as outlined below:

1. Use Inserta-Tee® (or approved equal) to make branch connections into existing piping, NPS 4 to NPS 20.
2. Make branch connections from side into existing piping, NPS 21 or larger, or to underground structures by cutting opening into existing unit large enough to allow three (3) inches 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 or structure wall, encase entering connection in six (6) inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    a. Use concrete that will attain a minimum 3,000 psi 28-day compressive strength.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
3. Protect existing piping and structures to prevent concrete or other debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.13 CLOSING ABANDONED SANITARY SEWER PIPE

A. 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 has been closed. Use either procedure below:

    1. Close open ends of piping with at least eight (8) inch thick brick masonry bulkheads.
    2. 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.

3.14 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

    1. Place plug in end of incomplete piping at end of day and when work stops.
    2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

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 the completion of the project.

    1. Submit separate reports for each system inspection.
    2. Defects requiring correction include:
        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 95 percent of piping diameter.
c. Crushed, broken, cracked, or otherwise damaged pipe.
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. Re-inspect and repeat procedure until results are satisfactory.

3.15 FIELD TESTING

A. General:

1. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
2. Leaks and loss in test pressure constitute defects that must be repaired.
3. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

B. Pressure Tests:

1. The Contractor shall furnish all pumps, piping, labor, and other materials and services necessary to bring the piping up to the specified test pressure.
2. All pipes shall be pressure tested. Pipes which will be pressurized under normal operating conditions shall conform to the requirements of the hydrostatic pressure test. All other piping shall meet the requirements of the air leakage test.
3. Pipe in the sections to be tested shall be backfilled or center loaded with thrust blocks installed and completely backfilled. Interior pipe supports and restraint systems shall be completely installed prior to testing.

C. Hydrostatic Pressure Test:

1. Test connections shall be made and the pipe filled with water. Unless otherwise specified, a pressure of not less than 1.25 times the normal operating pressure (for the lowest point on the pipe line) but not less than 100 psi or not more than the rated working pressure of the pipe shall be used for testing.
2. After air removal, water shall be pumped in to bring the pipe to the specified pressure. The hydrostatic test shall be of at least a 2-hour duration. Test pressure shall not vary by more than plus or minus five (5) psi for the duration of the test. After two hours, additional water shall be drawn from a container of known volume. The amount of water required to return the system to the specified pressure shall not exceed the amount determined by the following formula:

$$Q = SD(P)^{1/2}/133200 \qquad \text{(Equation 1)}$$

Where

Q = Total allowable leakage in gallons per hour.

S = Length of section tested, feet.
D = Nominal pipe diameter, inches.
P = Test pressure, psi.

3. The allowable leakage must not exceed the volumes specified below for each 1,000 feet of the particular diameter of pipe being tested (table has been calculated based on Equation 1):

Hydrostatic Testing Allowance per 1,000 ft of Pipeline – gph
(AWWA C 600)

Avg. Test Pressure	Nominal Pipe Diameter (in)										
(psi)	1.5	2	3	4	6	8	10	12	14	16	18
100	0.11	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35
125	0.13	0.17	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51
150	0.14	0.18	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66
175	0.15	0.20	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79
200	0.16	0.21	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91

4. All exposed pipe, fittings, valves, and joints shall be inspected and all evidence of moisture appearing on the surface of the ground during the test shall be investigated by the Contractor by excavation where the pipe has been covered with backfill. Should the leakage test results exceed allowable leakage, the test pressure shall be maintained for an additional period of time as directed by the Engineer to facilitate location of leaks.
5. All pipe, fittings, valves, pipe joints, and other materials which are found to be defective when the pipe line is tested shall be removed from the line immediately and replaced with new and acceptable material by and at the expense of the Contractor. The pressure test shall be repeated after repairing leaks and other defective work until the pipe line installation conforms to specified requirements and is accepted by the Engineer.

D. Air Leakage Test:

1. Contractor shall perform air tests for all pipe sizes.
2. Air leakage testing shall be performed on lies as specified and on the following lines:
    a. Outfall line
    b. Drain lines
    c. Sanitary sewer lines
3. Furnish all facilities required including necessary piping connections, test pumping equipment, pressure gauges, bulkheads, regulator to avoid over-pressurization, and all miscellaneous items required.
    a. The pipe plug for introducing air in to the line shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fitting to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional

valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.

b. The pressure test gauge shall meet the following minimum specifications:

i.	Size (diameter)	4-1/2 inches
ii.	Pressure Range	0-15 psi
iii.	Figure Intervals	1 psi increments
iv.	Minor Subdivisions	0.05 psi
v.	Pressure Tube	Burdon Tube or diaphragm
	Accuracy	+ 0.25% of maximum scale reading
vi.	Dial	White coated aluminum with black lettering, 270 degrees arc and mirror edge
vii.	Pipe Connection	Low male 1/2 inch NPT

Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air test are performed.

4. Test each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trench.
5. Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop to 2.5 psig. If the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than shown in the table below, the pipe shall be presumed to be free of defects.

Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q=0.0015

(ASTM F 1417, Table 1)

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 t
4	3:46	597	0.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38

15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the pressure air test.

6. In areas where ground water is known to exist, install a one-half inch diameter capped pipe nipple approximately 10 inches long, through manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, ground water level shall be determined by removing pipe cap, blowing air through pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

E. Deflection Tests:

1. Deflection tests shall be performed on all flexible sewer pipe by the Contractor using a mandrel pull. The mandrel shall have not less than seven (7) arms. The mandrel pull cannot be performed any sooner than 30 days after the reach being tested has been installed and final backfill has been placed.
2. A section of sewer line reach shall be deemed as failed when the mandrel cannot be moved through it with reasonable force. The tests shall be performed without mechanical pulling devices.
3. At the conclusion of the mandrel pull, the Contractor, at his expense, shall be required to remove and replace all pipe which fails the test.
4. The mandrel diameter shall be based on 95 percent of the actual inside pipe diameter.

F. Alignment Tests:

1. At the Owner’s or Engineer’s instruction the Contractor shall check the alignment of a sewer line using either a laser beam or lamping methods.

END OF SECTION 333100

SECTION 33 39 00
SEWER UTILITY SEWERAGE STRUCTURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: requirements and specifications necessary to install the sanitary sewer manholes and other structures, as shown on the project drawings.

B. Testing of the installed structures is incidental to the work.

C. Provide construction staking in accordance with generally accepted practice for layout of underground utilities.

D. The work includes coordination with building plumbing contractors and building plumbing plans.

E. Fees related to sewer service installation, whether tap, meter or other fees will be paid by the Contractor. Identify fees for installation of sewer services and provide written report to the Owner.

F. Connections between the new construction and existing mains may be made by the Local Jurisdiction. Sewer service may be brought to the property line by the Local Jurisdiction. Contractor shall verify the extent to Local Jurisdiction work and coordinate the work with the work of the Local Jurisdiction.

1.2 RELATED SECTIONS

A. Section 312300 Excavation and Fill for trenching, bedding, and backfill requirements.

B. Section 333900 Sanitary Utility Sewerage Piping for sewer pipe requirements.

1.3 GENERAL CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do no 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. Notify property owner not less than two days in advance of proposed utility interruptions.

1.4 SUBMITTALS

A. Product Data for the following:
   1. Manhole frames and covers

B. Shop Drawings: Include plans, elevations, details, and attachments for precast concrete manholes, including frames and covers.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions

PART 2 – PRODUCTS

2.1 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6 inch minimum thickness for floor slab and 4 inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 5 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 12 inch total thickness that match 24 inch diameter frame and cover.
8. Steps: ASTM C 478 plastic steps, individual steps. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12 to 16 inch intervals.
9. Pipe Connectors: ASTM C 923 resilient, of size required, for each pipe connecting to base section. A-LOK manhole pipe connector or equal.
    a. When connecting to an existing manhole, the manhole shall be cored drilled to allow new pipe to enter. Cutting or chipping the opening is not permitted. A rubber gasket and non-shrink grout shall be used to provide a tight seal around pipe.

B. Heavy-Traffic Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to structure, as required to prevent flotation.
2. Gaskets: Rubber.
3. Grade Rings: Include two or three reinforced-concrete rings, of 6 to 9 inch total thickness, that match 24 inch diameter frame and cover.
4. Steps: ASTM C 478 plastic steps, individual steps. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12 to 16 inch intervals. Omit steps for manholes less than 60 inches deep.
5. Pipe Connectors: ASTM C 923 resilient, of size required, for each pipe connecting to base section. A-LOK manhole pipe connector or equal.

C. Manhole Frames and Covers: ASTM A 48-76, Class 35. Standard manhole frames and covers shall have a minimum weight of 300 pounds and shall be Neenah R-1780A or

Deeter 1315 or approved equal. Include indented top design with lettering “SANITARY SEWER” cast into cover.

2.2 PROTECTIVE COATINGS

A. Description: One or two-coat, coal-tar epoxy; 1/8 inch minimum thickness, unless otherwise indicated; factory or field applied to the exterior surface of each manhole.

B. Manufacturer: Subject to compliance with requirements, provide coal-tar products of one of the following:

1. Celotex Corporation
2. GAF Corporation
3. Koppers Company, Inc.
4. Or approved qual

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavation is ready to receive work and excavations, dimensions, and elevations are as indicated on the project drawings.

3.2 EARTHWORK

A. Excavation, trenching, bedding, and backfilling are specified in Section 312300 Excavation and Fill.

B. Hand trim excavations to required elevations. Correct over excavation with bedding material.

C. Remove large stones or other hard matter that could damage structures or impede consistent backfilling or compaction.

3.3 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet. Manhole bottoms shall be formed to provide smooth continuous flow.

C. When manholes are installed in pavements, set tops of frames and covers flush with finished pavement surface. Set tops three (3) inches above finished surface in non-paved areas, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.4 PROTECTIVE COATING INSTALLATION

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prim materials manufacturer.

B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.

C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

D. Comply with manufacturer's recommendations except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work.

E. Cold Bitumen on Exterior Surfaces:

1. Apply a coat of cold, semi-fibrated, semi-mastic asphalt dampproofing material by brushing or spraying at rate certified by manufacturer to produce uniform dry film thickness of not less than 30 mils.

F. Dampproof Protection Course:

1. General: Where indicated, install protection course of type indicated, over completed-and-cured dampproofing treatment. Comply with dampproofing material manufacturer's recommendations for method of support or attachment of protection materials. Support with spot-application of plastic cement where not otherwise indicated.

3.5 CLOSING ABANDONED SANITARY SEWER STRUCTURES

A. Excavate around structure as required and use one procedure as outline below:

1. Remove structure and close open ends of remaining piping.
2. Remove top of structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
3. Backfill to grade according to Section 31 23 00 Excavation and Fill.

3.6 FIELD TESTING

A. Vacuum Testing of Manholes:

1. Each manhole shall be tested immediately after assembly and prior to backfilling.
2. All lift holes shall be plugged with an approved non-shrink grout.
3. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.
4. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendations. Test head shall be as manufactured by P.A. Glazier, Inc. of Worcester, Massachusetts, or equal.
5. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in the following table:

Minimum Test Times for Various Manhole Diameters in Seconds
(ASTM C 1244, Table 1)

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
	Time, seconds								
8	60	60	60	60	60	60	60	60	60
10	60	60	60	60	60	60	60	60	60
12	60	60	60	60	60	60	60	60	60
14	60	60	60	60	60	60	60	60	60
16	60	60	60	60	60	60	60	60	67
18	60	60	60	60	60	60	60	65	73
20	60	60	60	60	60	60	65	72	81
22	60	60	60	60	60	64	72	79	89
24	60	60	60	60	60	64	78	87	97
26	60	60	60	60	64	75	85	94	105
28	60	60	60	60	69	81	91	101	113
30	60	60	60	63	74	87	98	108	121

END OF SECTION 333900

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: construction of storm sewer piping as indicated on the project drawings.

1.2 RELATED SECTIONS

A. Section 312300 Excavation and Fill for trenching, bedding, and backfill requirements.

B. Section 334900 Storm Drainage Structures for storm drainage system structure requirements.

1.3 SUBMITTALS

A. Product Data for the following:

1. Pipe, flared-end sections, and other storm water piping accessories.

1.4 QUALITY ASSURANCE

A. Applicable Standards:

1.	AASHTO M 294	High Density Polyethylene Pipe
2.	AASHTO M 36	Aluminized Steel
3.	AASHTO M 274	Aluminized Steel
4.	ASTM A 760	Pipe and Coupling Bands
5.	ASTM C 76	Concrete Pipe and Testing
6.	ASTM C 497	Concrete Pipe and Testing

PART 2 – PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. High density polyethylene pipe shall conform with AASHTO M 294, type S (non-perforated circular cross section with corrugated outer surface and a smooth inner surface) for pipe diameters of 15 inches to 60 inches, inclusive.

B. Joints may be either bell-and-spigot, gasketed joints or made with external coupling bands. Joint integrity shall conform to the performance requirements of AASHTO M 294. Joints shall be soil tight.

C. Fittings and coupling bands shall be fabricated from the same material as the pipe and shall prevent the infiltration of soil into the pipe.

D. Coupling bands shall cover at least two full corrugations on each section of pipe and shall prevent the infiltration of soil into the pipe.

E. HPDE Flared end sections shall not be permitted on the Project.

2.2 CORRUGATED METAL PIPE (ALUMINIZED)

A. Pipe shall conform to AASHTO M 36 and M 274.

B. Pipe shall be Type 2 Aluminized Steel with manning's n value no greater than 0.013.

C. Metal end sections shall be galvanized (AASHTO M 218) meal with toe plates.

D. Pipe shall be of size, length and gauge thickness as indicated.

E. Pipe and coupling bands shall conform to ASTM A 760/A 760M.

2.3 REINFORCED CONCRETE PIPE (RCP)

A. Materials for reinforced concrete pipes shall be supplied, fabricated, and tested in accordance with the latest edition of ASTM C 76 and all other related specifications noted therein.

PART 3 – EXECUTION

3.1 TRENCHING AND BACKFILLING

A. Contractor shall perform trenching and backfilling for storm water piping as specified in Section 31 23 00 Excavation and Fill, and as indicated on the project drawings.

3.2 PIPE INSTALLATION

A. General: All pipe shall be carefully laid true to lines and grades indicated. Any pipe which is not in true alignment or which shows undue settlement after laying shall be taken up and relayed at the Contractor's expense.

B. High Density Polyethylene (HDPE) Pipe and Corrugated Metal Pipe (CMP):

1. Install to conform to manufacturer's recommendations.
2. Lift or roll pipe to protect coating. Do not drag over gravel or rock. Avoid striking rocks or hard objects when lowering into trench. Pipe on which coatings have been damaged may be rejected at the site of the work regardless of previous approvals.
3. Join pipe sections with firmly bolted coupling bands of the same material.
4. All pipe shall have end sections compatible with the pipe which provides a smooth invert.

C. Reinforced Concrete Pipe (RCP):

1. Install to conform to manufacturer's recommendations.
2. Joints may be one of the following:
    a. Flexible Neoprene Gaskets of the proper size conforming to the requirements of ASTM C 443.

b. Bituminous Mastic Joint Compound. This compound shall be a homogeneous blend of bituminous material, inert filler, and suitable solvents or plasticizing compounds thoroughly mixed at the factory to a uniform consistency.

3.3 CLEAN-UP

A. Upon completion of work, remove forms, equipment, protective covering, and rubbish from premises. Carefully clean interior of storm water piping of dirt, rubbish, and surplus mortar and leave clean and smooth upon completion of the project.

END OF SECTION 334100

SECTION 33 49 00
STORM DRAINAGE STRUCTURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: requirements and specifications necessary for construction of storm sewer structures as indicated on the project drawings.

B. Provide construction staking in accordance with generally accepted practice for layout of underground utilities.

1.2 RELATED SECTIONS

A. Section 312300 Excavation and Fill for trenching, bedding, and backfill requirements.

B. Section 321313 Concrete Paving for concrete material and mixture requirements.

C. Section 334100 Storm Utility Drainage Piping for storm drainage system piping requirements.

1.3 SUBMITTALS

A. Product Data for the following:

1. Manhole frames and covers

B. Shop Drawings: Include plans, elevations, details, and attachments for precast concrete drainage structures, including frame and covers.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle precast concrete drainage structures according to manufacturer's written rigging instructions.

PART 2 – PRODUCTS

2.1 PRECAST REINFORCED CONCRETE STRUCTURES

A. Construction of precast reinforced concrete structures shall be in conformance with ASTM C 478.

B. Concrete materials and mix design requirements shall be in conformance with Section 321313 Concrete Paving.

C. Reinforcement shall be in accordance with the project drawings and in conformance with Section 321313 Concrete Paving.

2.2 PVC/HDPE STRUCTURES

A. PVC or HDPE structures shall be Nyloplast® Engineered Drainage Structures or approved equal.

PART 3 – EXECUTION

3.1 EXCAVATION AND BACKFILLING

A. Contractor shall perform excavation and backfilling for storm water structures as specified in Section 312300 Excavation and Fill, and as indicated on the project drawings.

3.2 STRUCTURE INSTALLATION

A. General: All structures shall be carefully installed true to lines and grades indicated. Any structure which is not in true alignment or which shows undue settlement after installation shall be removed and reinstalled at the Contractor's expense.

B. Precast reinforced concrete structures:

1. Handle and place precast concrete drainage structures according to manufacturer's written rigging instructions.
2. Floor of structure shall be cast-in-place; concrete used shall comply with Section 321313 Concrete Paving.
3. All joints shall receive mastic joint sealant, RAM-NEK or approved equal.

C. PVC/HDPE Structures

1. Installation shall be in conformance with manufacturer's installation instructions.

3.3 CLEAN-UP

A. Upon completion of work, remove forms, equipment, protective covering, and rubbish from premises. Carefully clean interior of storm water structures of dirt, rubbish, and surplus mortar and leave clean and smooth upon completion of the project.

END OF SECTION 334900

APPENDIX A:
BID DOCUMENTS

BID PROPOSAL FORM

OWNER/PROJECT INFORMATION:

Owner: **Marshfield R-I School District**
Project Name: **20-602: Marshfield Early Childhood Center**
Design Professional: Paragon Architecture, 637 W. College Street, Springfield, MO 65806
Construction Manager: RE Smith Construction Company, 1036 West 2nd St., Joplin, MO 64801

BIDDER INFORMATION:

Legal Entity Name:

_____

Address:

_____

Phone Number:

_____

Contact Email Address:

_____

BIDDERS REPRESENTATION:

THE UNDERSIGNED HEREBY REPRESENTS that by making this bid, the bidder has: (1) read and understood the proposed Construction Documents, which include the General Conditions, Supplementary Conditions, Division-01 General Requirements, the Specifications, and the Drawings; and that this Bid is made in accordance therewith, including all quantities and requirements; (2) visited the project site, has familiarized him or herself with the local conditions under which the Work is to be performed including qualified labor availability, and that he/she has correlated his observations with the requirements of the proposed Construction Documents; and (3) has made this Bid based upon the materials, systems, assemblies and equipment required by the proposed Construction Documents.

THE UNDERSIGNED ACKNOWLEDGES that in signing this Bid, he waives all rights to plead any misunderstandings regarding the same. The Undersigned understands that his competence and responsibility and that of his proposed subcontractors, the time of completion, as well as other factors of interior to the Owner, may be consideration in making the award of this Contract. The Undersigned acknowledges that the Owner reserves the right to reject any or all bids, and to waive any informality or irregularity concerning the bids received as may be in the Owner's interest.

BASE BID COST PROPOSAL:

Bid Package #: _____

INDICATE AMOUNTS BELOW in both words and figures. In the case of a discrepancy between the words and the figures, the words will govern.

THE BIDDER HEREBY AGREES AND AFFIRMS to enter into a construction Contract to provide all labor, materials, equipment and services necessary to perform the Work described in the Contract Documents, including all addenda issued thereto, for the **Base Bid Sum** of:

Written amount: _____ DOLLARS
Numeric amount: $ _____.00

Additional Cost for 100% Performance & Payment Bond:

Written amount: _____ DOLLARS
Numeric amount: $ _____.00

ALTERNATES:

THE UNDERSIGNED PROPOSED the following amounts as additions to or deductions from the Base Bid Sum indicated above, in accordance with **Section 01 23 00 – Alternates** for descriptions of the alternative Work to be included. The Owner reserves the right to accept or reject alternates as deemed to be in his best interest, in any order or sequence, and to reject all alternates. Except for "Optional" Alternates, a Bidder's failure to provide an alternate cost proposal may be consideration for rejection of the Bid Proposal, as being un-responsive:

ALTERNATE #1 – EARLY CHILDHOOD PARKING LOT EXTENSION:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____.00

ALTERNATE #2 – ENTRY FEATURE WALL:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____.00

ALTERNATE #3 – DIMENSIONAL LETTERING & WALLCOVERING AT RECEPTION:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____.00

ALTERNATE #4 – LIBRARY READING NOOK INSET:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____ .00

ALTERNATE #5 – WALL PANELS IN CORRIDOR:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____ .00

ALTERNATE #6 – HILL WALL FEATURE IN CORRIDOR:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____ .00

ALTERNATE #7 – VINYL DOTS & STRIPES AT ALL CLASSROOMS:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____ .00

ALTERNATE #8 – FLOOR TILE IN LIEU OF SEALED CONCRETE AT PUBLIC RESTROOMS:

Circle One. Indicate whether to ADD or DEDUCT the following amount:

Written amount: _____ DOLLARS

Numeric amount: $ _____ .00

UNIT PRICES:

THE UNDERSIGNED PROPOSES the following amounts as Unit Prices, to be applied against such itemized changes to the Scope of Work, in accordance with **Section 01 22 00 – Unit Prices**. In the event it is found necessary to perform such changes, the Work will be paid for as extra or credited to the Contract amount on the basis of the following unit prices, which are to include all direct and indirect costs, overhead, profit, taxes, insurance and bonds, if applicable.

ITEM NO.	WORK CATEGORY	Per UNIT	UNIT COST AMOUNT
1	General excavation and removal from site of unclassified material or unsuitable materials. Fill in one price only.	Cubic Yard	$
2	General excavation and relocation "on-site" of unclassified material or unsuitable materials.	Cubic Yard	$
3	Trench excavation including backfill replacement.	Cubic Yard	$
4	Compacted drainage fill, in place (clean ¾" crushed stone).	Cubic Yard	$
5	Compacted granular fill, in place (base rock and gravel).	Cubic Yard	$
6	Mass rock removal – disposal off-site and replacement with satisfactory fill.	Cubic Yard	$
7	Engineered fill below floor-slabs or pavement.	Cubic Yard	$
8	Earth borrow; in place (non-structural) from off-site material	Cubic Yard	$
9	Compacted engineered fill or structural fill; in place (from site material)	Cubic Yard	$
10	Rock excavation – pit rock	Cubic Yard	$
11	Import and placement of shot-rock stabilization material (4" – 6" clean rock)	Cubic Yard	$
12	Import and placement of shot-rock stabilization material (6" minus rock)	Cubic Yard	$
13	Import and placement of shot-rock stabilization material (1" +/- rock)	Cubic Yard	$
14	Lean concrete (for backfill of footing over excavation if required)	Cubic Yard	$
15	Compacted Low Volume Change Layer. Cost for more or less than that shown on plans.	Cubic Yard	$

ADDENDA:

The Bidder hereby acknowledges receipt and inclusion in the Bid Proposal the following addenda (number and date):

Addendum No. 1 through_____

BIDDER'S ENTITY FORMATION:

Please check and complete the following:

Contractor's license no. (when applicable): _____

_____ Company is sole proprietorship

_____ Company is a partnership

_____ Company is a corporation or limited liability company organized under the laws of

the State of: _____

If a partnership, corporation or limited liability company, list owners, partners, officers and members:

_____
_____
_____
_____

BIDDER'S EXECUTION:

THE PERSON SIGNING BELOW CERTIFIES that he or she is fully authorized and empowered to execute this instrument, and to bind the Bidder hereto, and does in fact so execute this instrument.

DATED THIS _____ DAY OF _____ , 20___

EXECUTED FOR THE BIDDER BY:

Legal Entity Name: _____

dba (if applicable): _____

Address: _____

City and State: _____

By: _____
Signature of Authorized Officer

_____
Title

ATTEST BY NOTARY PUBLIC:

STATE OF _____
COUNTY OF _____

On this _____ day of _____, before me the undersigned, a Notary Public, in and for the County and State aforesaid, personally appeared _____, to me known to be the person who executed the foregoing instrument in my presence and acknowledged to me that he/she executed the same as his free act and deed.
IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal the day and year last above written.

_____
NOTARY PUBLIC
My Commission Expires:_____

E-VERIFY AFFIDAVIT

Project Name: **Marshfield Early Childhood Center, 600 N Locust St, Marshfield, MO 65706**

Contractor
_____, being first duly sworn, deposes and says that he/she is_____ of _____ (sole owner, a partner, president, secretary, etc) the party making the foregoing Bid is a participating Employer in the Department of Homeland Security (DHS) E-Verify program for Employment Verifcation . The Bidder has full understanding of the requirements set forth in the E-Verify Memorandum of Understanding (MOU), and the Bidder does not knowingly employ illegal aliens. Upon award of Bid and at the Contract Execution, the successful Bidder shall provide **Marshfield R-I School District** with the following documentation:

1. E-Verify Memorandum of Unerstanding (MOU)
2. E-Verify Company Profile Page

Signed:

_____
Contractor

_____
Title

_____
Address

_____
Company ID Number

State of

County of

On this _____day of _____ in the year_____ , before me, the undersigned notary public, personally appeared_____ , known to me to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged that he/she/they executed the same for the purposes therein contained. In witness whereof, I hereunto set my hand and official seal.

Seal of Notary:

_____
Notary Public

APPENDIX B: REFERENCE

Advancement of Construction Technology

SUBSTITUTION REQUEST

(During the Bidding Phase)

Project _____

_____

To: _____

_____

Re: _____

Substitution Request Number: N/A

From: _____

Date: _____

A/E Project Number: _____

Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____

Signed by: _____ ***Signature required***

Firm: _____

Address: _____

_____

Telephone: _____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

Advancement of Construction Technology

SUBSTITUTION REQUEST
(After the Bidding Phase)

Project: _____

_____

_____

To: Paragon Architecture

_____

_____

Re:

Substitution Request Number: N/A

From: _____

Date: _____

A/E Project Number: _____

Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached - REQUIRED BY Fill in if required

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☑ Drawings ☑ Product Data ☐ Samples ☑ Tests ☑ Reports ☐ _____

SUBSTITUTION REQUEST
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

_____

_____

_____

_____

_____

_____

DIVISION OF LABOR STANDARDS

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 ☐ Contractor ☐ Subcontractor		Address of Contractor or Subcontractor: City:	State: ZIP:	Phone Number: ( ) -
Name of Public Body		Address of Public Body: City:	State: ZIP:	Phone Number: ( ) -
Payroll No.	For Week Ending / /	AWO	Project and Location	Project or Contract No.

1. Name and Address of Employee	2. Occupational Title ***	3. Day and Date								4. Total Hours	5. Hourly Rate + Cash Fringe	6. Gross Amt	7. Deductions					8. Net Wages Paid for Week
		Day																
		Date																
		Hours Worked Each Day										Project / Week	FICA and Medicare	Federal and State Withholding Tax	Other A	Other B	Total Deductions	
		DT																
		OT																
		ST																
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****** *If a worker performs work in more than one occupational title, you must separately list the hours worked per occupational title and wage rates.* ***

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)	Appren-tice 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 _____ *(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.

DIVISION OF LABOR STANDARDS

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

AFFIDAVIT
COMPLIANCE WITH THE PREVAILING WAGE LAW

I, _____, upon being duly sworn upon my oath state that: (1) I am the
(Name)

_____ of _____; (2) all requirements of
(Title) *(Name of Company)*

§§ 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 _____;
(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 worker 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 made 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. _____ Section _____ issued by the Missouri Division of Labor Standards and applicable to this project located in _____ 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 _____, _____.

_____
Notary Public

_____
Receipt by Authorized Public Representative

Missouri Department of Labor and Industrial Relations is an equal opportunity employer/program.

Reset Form Print Form

Form **5060**

Missouri Department of Revenue
Project Exemption Certificate

This form is to be completed and given to your contractor.

Exempt Entity and Project Information

Name of Exempt Entity Issuing the Certificate			Missouri Tax Exemption Number
Address	City	State	ZIP Code
E-mail Address			
Project Number	Project Begin Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___	Estimated Project End Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___	
Description of Project			
Project Location		Certificate Expiration Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___	

Provide a signed copy of this certificate, along with a copy of the exempt entity's Missouri Sales and Use Tax Exemption Letter to each contractor or subcontractor who will be purchasing tangible personal property for use in this project. It is the responsibility of the exempt entity to ensure the validity of the information on the certificate. The exempt entity must issue a new certificate if any of the information changes.

Signature of Authorized Exempt Entity	Printed Name of Authorized Exempt Entity	Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___

Contractor

The Missouri exempt entity named above hereby authorizes the purchase, without sales tax, of tangible personal property to be incorporated or consumed in the construction project identified herein and no other, pursuant to **Section 144.062, RSMo.** Under penalties of perjury, I declare that the above information and any attached supplement is true, complete, and correct.

Name of Purchasing Contractor	Signature of Contractor	Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___

Address	City	State	ZIP Code

Subcontractor

Contractors - Present this to your supplier in order to purchase the necessary materials tax exempt. Complete the Subcontractor portion if extending the certificate to your subcontractor. The contractor must sign the form in the space provided below.

Name of Purchasing Subcontractor			
Address	City	State	ZIP Code

Signature of Contractor	Contractor's Printed Name	Date (MM/DD/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___

Taxation Division
P.O Box 358
Jefferson City, MO 65105-0358

Phone: (573) 751-2836
Fax: (573) 522-1271
E-mail: salestaxexemptions@dor.mo.gov

Visit **http://dor.mo.gov/business/sales/sales-use-exemptions.php** for additional information.

Geotechnical Engineering Report

Marshfield R-I School District Early Childhood Center
Marshfield, Missouri
March 16, 2021
Terracon Project No. B5215010

Prepared for:
Paragon Architecture, LLC
Springfield, Missouri

Prepared by:
Terracon Consultants, Inc.
Springfield, Missouri

March 16, 2021

Paragon Architecture, LLC
637 W. College Street
Springfield, Missouri 65806

Attn: Ms. Kirsten Whitehead, AIA
P: 417-885-0002
E: whitehead@paragonarchitecture.com

Re: Geotechnical Engineering Report
Marshfield R-I School District Early Childhood Center
600 N Locust Street
Marshfield, Missouri
Terracon Project No. B5215010

Dear Ms. Whitehead:

We have completed a subsurface exploration and geotechnical engineering exploration for the referenced project. This study was performed in general accordance with Terracon Proposal No. PB5215010, dated February 17, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

STATE OF MISSOURI
TY G
ALEXANDER
NUMBER
PE-2009002087
PROFESSIONAL ENGINEER

Joshua D. Elson, R.G.
Project Geologist

Ty G. Alexander, P.E.
Office Manager/Principal
Missouri: PE-2009002087

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

A geotechnical exploration has been performed for the proposed Early Childhood Center located at 600 N. Locust Street in Marshfield, Missouri. Five (5) borings, designated B-1 through B-5, were performed to depths of approximately 12 to 25 feet below the existing ground surface. The following geotechnical considerations were identified:

- The fat clay (CH) soils encountered in the soil exploration program are high in plasticity and prone to volume change with variations in moisture content. For this reason, we recommend a 24-inch thick Low Volume Change (LVC) zone be maintained or constructed beneath grade-supported floor slabs.

- Some relatively high moisture content soils were encountered in the upper levels of some of the borings, and may be exposed in excavations and cuts. These soils may become unstable when disturbed. During periods of dry weather, these soils may be stable upon initial exposure; however, these soils, if exposed, may become relatively soft and unstable under construction traffic. We recommend that the owner budget for the possibility that overexcavation and/or subgrade stabilization may be required and contractors be prepared to handle potentially unstable and/or soft conditions.

- Auger refusal was encountered at varying depths across the site indicating the subject site is located over a pinnacled bedrock unit. Pinnacles may extend into foundation and utility excavations. Accordingly, we recommend the owner obtain unit rates for rock excavation which may be required for shallow foundation construction and utility installation.

- Based on our borings, the International Building Code (IBC) seismic site class for this site is C.

The professional opinions and recommendations presented in this report are based on evaluation of data developed by testing discrete samples obtained from widely-spaced borings. Site subsurface conditions have been inferred from available data, but actual subsurface conditions will only be revealed by excavation. So that variations in subsurface conditions which may affect the design can be addressed as they are encountered, we recommend that Terracon be retained to observe excavations and perform tests during the site preparation, earthwork and foundation construction phases of the project.

This executive summary should not be separated from or used apart from this report. This report presents fully developed recommendations and opinions based on our understanding of the project at the time the report was prepared. The report limitations are described in the **General Comments** section of this report.

Geotechnical Engineering Report

Marshfield R-I School District Early Childhood Center

600 N Locust Street

Marshfield, Missouri

Terracon Project No. B5215010

March 16, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Marshfield R-I School District Early Childhood Center to be located at 600 N Locust Street in Marshfield, Missouri. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification

The geotechnical engineering services for this project included the advancement of Five (5) test borings to depths ranging from approximately 11 to 25 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

The **General Comments** section provides an understanding of the report limitations.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 600 N Locust Street in Marshfield, Missouri. The approximate coordinates of the site are: Lat.: 37.3438° N Long.: 92.8978° W (See **Site Location**)

Item	Description
Existing Improvements	Existing elementary school and playground with associated parking, drive areas and sidewalks
Current Ground Cover	Primarily grass covered lawn utilized as a playground area
Existing Topography	Based upon review of UGSG 7.5-minute quadrangle topographic map, the site gently slopes from north and west to south and east
Geology	Based on the Geological Map of Missouri prepared by the Missouri Department of Natural Resources (MDNR), the subject site is located over the Jefferson City and Cotter Dolomite Bedrock Units. The Jefferson City and Cotter Formation is composed primarily of dolomite and some sandstone. Small amounts and layers of shale and chert are noted within this bedrock unit.
Geological Concerns	Solution features, including springs, caves, and sinkholes, are commonly present in the Jefferson City and Cotter Dolomites in this area. Based on the review of information available from Missouri Department of Natural Resources (MDNR) GIS databases, the subject site does not contain any previously identified sinkhole formations, although sinkholes and/or springs are noted on the **Geologic Map** in the vicinity of the site. It is difficult to predict future sinkhole activity. Site grading and drainage may alter site conditions and could possibly cause sinkholes in areas that have no history of this activity.

PROJECT DESCRIPTION

The table below presents a brief summary of our project understanding. This summary has been used as the basis of our analyses and recommendations. Any changes to this summary should be made known to Terracon immediately so revisions can be provided if necessary.

Item	Description
Information Provided	Information was provided by Ms. Kirsten Whitehead, AIA, with Paragon.
Project Description	The project consists of construction of a new Early Childhood Center with a FEMA Safe Room
Proposed Structures	The project includes a single-story building with a footprint of about 23,200 square feet. The building will be slab-on-grade (non-basement).
Building Construction	Not provided. Based on our experience, we anticipate the structure will be supported by pre-cast concrete or load-bearing masonry walls with a concrete slab-on-grade floor.
Finished Floor Elevation	Not provided at this time; however, based on our understanding of site grades, we anticipate the FFE will be within 2 to 3 feet of existing grade, near the elevation of the existing elementary school building.

Item	Description
Maximum Loads (Estimated)	■ Columns: 120 kips ■ Walls (FEMA): 12-18 kips per linear foot (klf) ■ Walls (Non-FEMA): 3-5 klf ■ Slabs: 150 pounds per square foot (psf)
Grading/Slopes	Unknown at this time; however, we anticipate site grading will be limited to approximately 3 feet of cut and fill.
Below-Grade Structures	None anticipated
Free-Standing Retaining Walls	Retaining walls are not expected to be constructed as part of site development.

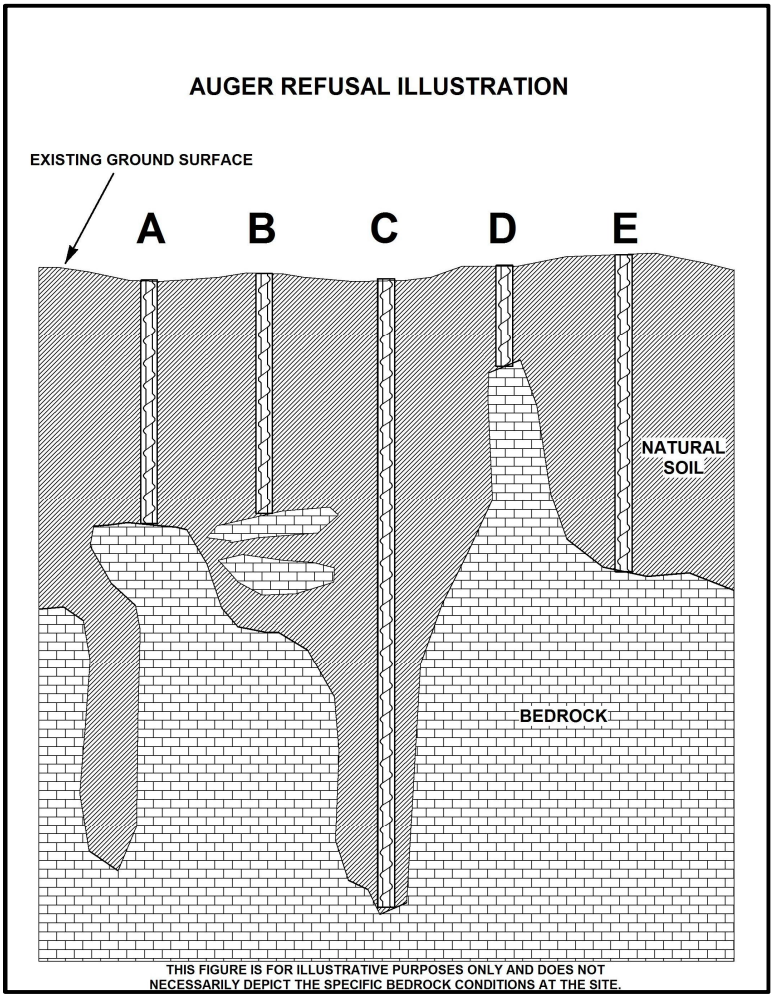
GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Lean Clay**	Lean clay with varying amounts of gravel
2	**Fat Clay**	Fat clay with varying amounts of gravel
3	**Bedrock**	Dolomite

Auger refusal is defined as the depth below the ground surface at which a boring can no longer be advanced with the soil drilling technique being used. Auger refusal is subjective and is based upon the type of drilling equipment used, the types of augers used, and the effort exerted by the driller. Auger refusal can occur on the upper surface of discontinuous bedrock (A), slabs of unweathered rock suspended in the residual soil matrix or "floaters" (B), in widened joints that may extend well below the surrounding bedrock surface (C), on rock "pinnacles" (D) rising above the surrounding bedrock surface, or on the upper surface of continuous bedrock (E). These possible auger refusal conditions are illustrated in the figure below. Linear interpolation of apparent bedrock elevations based upon the boring data is often used but can misrepresent actual rock removal quantities where anomalies exist, such as pinnacled rock, where rock could be shallower than that encountered in the borings. Additional borings, auger probes, test pits, or geophysical testing could be performed to obtain more specific bedrock information.



Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes are shown on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Depth to Groundwater while Drilling (feet) [1]	Approximate Depth to Groundwater after Drilling (feet) [1]
B-1	23	24

1. Below ground surface

Groundwater was not observed in the remaining borings while drilling, or for the short duration the borings were left open prior to backfilling. However, this does not necessarily mean the borings

terminated above groundwater, or the water levels summarized above are stable groundwater levels. Due to the low permeability of the soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells, sealed from the influence of surface water, are often required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be different than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

General

We recommend that the exposed subgrade be thoroughly evaluated after stripping of any topsoil and at the base of all cut areas, and prior to the start of any fill operations. We recommend that the geotechnical engineer be retained to evaluate the bearing material for the foundations and subgrade soils. Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed project plans known to us at this time.

Karst development is a common occurrence in this area due to the dissolution of the native limestone and dolomite bedrock material. Though no evidence of sinkholes was noted in the review of topography and in the borings performed at the subject site, the development of karst features on the site is a possibility over time. The current state of the practice in geotechnical engineering does not allow for the accurate prediction of when or where sinkholes or karst-related subsidence could occur. The owner is advised that construction on this property or essentially any other site within this area, carries with it some risk that future sinkholes may develop.

Swell Potential

High plastic clays were noted in the Atterberg limits tests performed on selected samples. These materials are prone to volume change with changes in moisture which may lead to excessive shrinking and swelling of floor slabs and lightly-loaded structures. We recommend a low volume change (LVC) zone be constructed beneath the at-grade floor slab. Using an LVC zone as recommended in this report may not eliminate all future subgrade volume change and resultant floor slab movements. However, the procedures outlined herein should help to reduce the potential for subgrade volume change. Existing soils can be left in place and compacted if they

are tested during construction and meet LVC material requirements. Details regarding this LVC zone are provided in the **Floor Slab** section**.**

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structure could occur. The severity of cracking and other (cosmetic) damage such as uneven floor slabs will likely increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if more extensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

All grades must provide effective drainage away from the structure during and after construction. Water permitted to pond next to the structure can result in greater soil movements than those discussed in this report. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. The recommendations made in this this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Soft Subgrade Potential

The subgrade soils may become unstable when disturbed. During periods of dry weather, these soils may be stable upon initial exposure, however, these soils could become relatively soft and unstable under construction traffic. Further, depending upon site conditions during construction, overexcavation or stabilization of the subgrade and/or base of overexcavations may be needed to achieve a suitable working surface. Accordingly, we recommend that the owner budget for the possibility that overexcavation and/or subgrade stabilization may be required and contractors be prepared to handle potentially unstable and/or soft conditions.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement.

Site Preparation

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded, tandem-axle dump truck. The proofrolling should be observed by the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently

addressed by the Geotechnical Engineer. Such areas should either be removed or modified by following the recommendations in the **Subgrade Stabilization** section. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

Subgrade Stabilization

Methods of subgrade improvement, as described below, could include scarification, moisture conditioning and recompaction, and removal of unstable materials and replacement with granular fill (with or without geosynthetics) and chemical stabilization. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of the area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help to reduce the amount of subgrade stabilization required.

If the exposed subgrade is unstable during proofrolling operations, it could be stabilized using one of the methods outlined below.

- **Scarification and Compaction** – It may be feasible to scarify, dry, and compact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.

- **Crushed Stone** – The use of crushed stone or gravel is the most common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 6 to 30 inches below finished subgrade elevation with this procedure. The use of high modulus geosynthetics (i.e., geotextile or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the geotextile or geogrid, we recommend that all below-grade construction, such as utility line installation, be completed to avoid damaging the geosynthetic. Equipment should not be operated above the geosynthetic until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over the geotextile or geogrid should meet the manufacturer's specifications, and generally should not exceed 1½ inches.

- **Chemical Stabilization** – Improvement of subgrades with Portland cement, lime, lime kiln dust (Code L), or Class C fly ash could be considered for improving unstable soils. Chemical modification should be performed by a prequalified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto

adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, evaluating various admixtures, the optimum amounts required, the presence of sulfates in the soil, and freeze-thaw durability of the subgrade.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Fill Material Types

Materials used for fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
High Plasticity Material	CH (LL≥70 or PI≥40)	3 feet below base of floors and other lightly-loaded structures; 2 feet below foundations; and 1 foot below base of pavements
Moderate to High Plasticity Material [2]	CH or CL, with 70>LL≥45 or 40>PI≥25	2 feet below base of floor slabs and any other lightly-loaded structures, 1 foot below base of pavements
Granular Material [3]	GM, GC, SM, or SC	All locations and elevations
Low Plasticity Material [4]	CL (LL<45 & PI<25) or Granular Material [3]	

1. Compacted structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation. On-site soils generally appear suitable for use as fill, subject to the "acceptable location for placement" limitations described in this table.
2. Delineation of moderate to high plasticity clays should be performed in the field by a representative of the Geotechnical Engineer, and could require additional laboratory testing. If fat clay material contains greater than 35 percent granular material retained on a ¾-inch sieve, it may be used in the low volume change zone.
3. Crushed limestone aggregate, limestone screenings or granular material such as sand, gravel or crushed stone containing at least 15 percent low plasticity fines.
4. Low plasticity cohesive soil or granular soil having low plasticity fines. Material should be approved by the geotechnical engineer.

Fill Compaction Requirements

Fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness[1]	9 inches or less in loose thickness

Item	Description
Compaction Requirements[2]	At least 95 percent of the material's maximum standard Proctor dry density[3]
Water Content Range	Low plasticity cohesive: -2 percent to +2 percent of optimum[3] High plasticity cohesive: 0 to +4 percent of optimum[3] Granular: Workable moisture levels[4]

1. Reduced lift thicknesses of 4 to 6 inches are recommended in confined areas (e.g., utility trenches, foundation excavations, and foundation backfill) and when hand-operated compaction equipment is used.
2. We recommend that engineered fill be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved. As stated within ASTM D 698, this procedure is intended for soils with 30 percent or less material larger than ¾ inch. Accordingly, we recommend full time proofroll observation be performed instead of moisture density testing for materials containing more than 30 percent aggregate retained on the ¾-inch sieve.
3. As determined by the standard Proctor test (ASTM D 698).
4. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability lean clay. The trench plug material should be placed to surround the utility line. If used, the lean clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been

achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade becomes excessively wet or dry, frozen, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to further construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be observed and tested by a representative of the Geotechnical Engineer. Observation and testing should include documentation of removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unacceptable conditions are encountered, the Geotechnical Engineer should be contacted to recommend mitigation options.

SHALLOW FOUNDATIONS

Provided the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for design of shallow foundations.

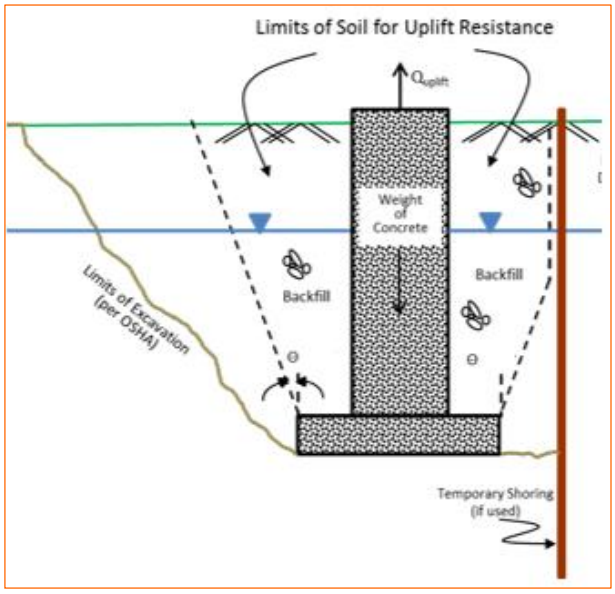
Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing pressure [1, 2, 3]	2,000 psf (foundation bearing on undisturbed soils)
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Ultimate Passive Resistance [4] **(equivalent fluid pressures)**	250 pcf (cohesive backfill) 350 pcf (granular backfill)
Ultimate Coefficient of Sliding Friction [5]	0.32 (native clay) 0.40 (granular material)
Minimum Embedment below Finished Grade	30 inches on soil
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 6]	About ¾ of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20 percent within 10 feet of the structure.
2. Values provided are for the maximum loads noted in **Project Description**.
3. Unsuitable or soft soils, should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions. Should be neglected if passive pressure will be used to resist lateral loads.
6. Differential settlements are as measured over a span of up to 50 feet.

Design Parameters - Uplift Loads

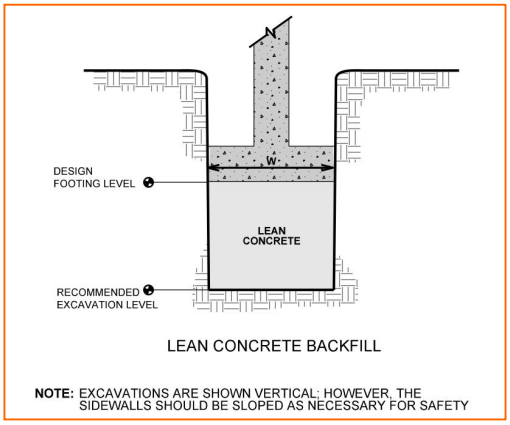
Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, q, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 100 pcf should be used for the backfill. This unit weight should be reduced to 40 pcf for portions of the backfill or natural soils below the groundwater elevation.



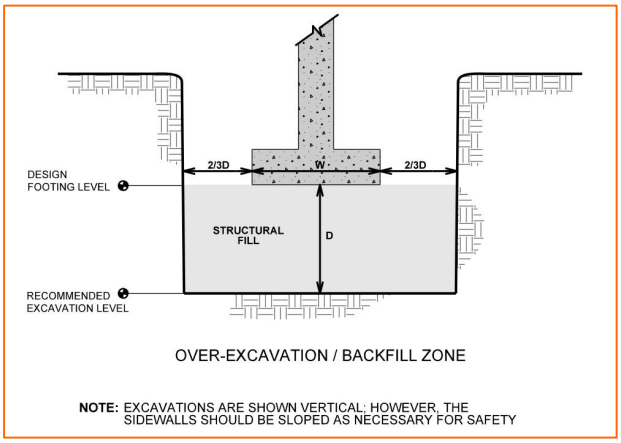
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be observed and tested by a representative Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed. Placement of a lean concrete mudmat over the bearing soils should be considered if the excavations must remain open for an extended period of time.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation with suitable fill materials, as recommended in the **Earthwork** section.



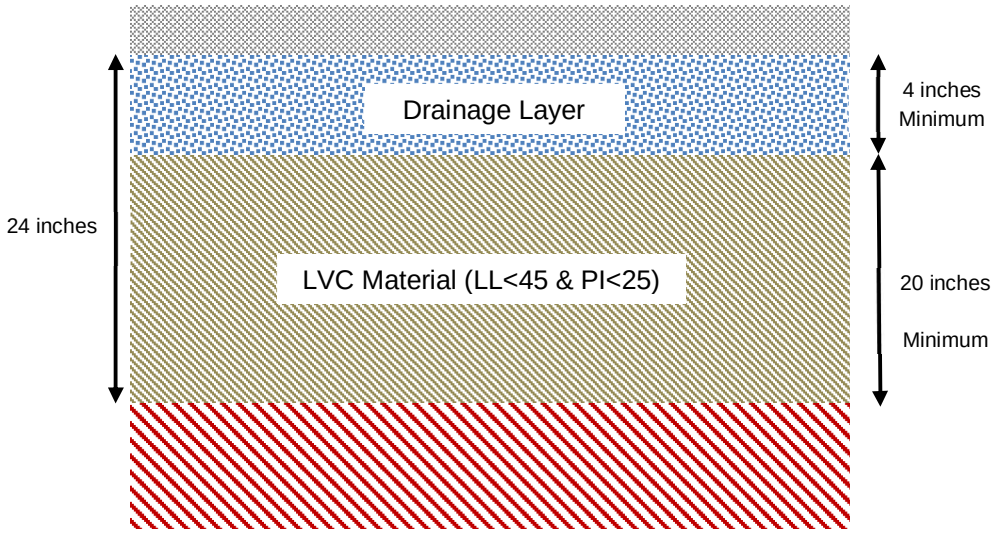
SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. The Site Class is required to determine the Seismic Design Category for a structure. The Site Class is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the subsurface conditions encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Class is C**. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. We could perform additional deeper borings or geophysical testing to confirm the conditions below the current boring depths.

FLOOR SLABS

Grade-supported floor slabs should be supported on a minimum of 24 inches of LVC material. LVC fill should be placed and compacted as recommended in section **Earthwork**.

Concrete Slab-on-Grade



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Floor Slab Design Parameters

Item	Description
Floor slab support [1, 2]	A minimum 24-inch thick low volume change (LVC) layer over suitable native soil or engineered fill
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in) for point loading conditions
Granular course beneath slab [3, 4, 5]	Minimum 4 inches
Capillary break layer thickness [4, 5]	Minimum 4 inches

1. We recommend an LVC layer be present below the floor slab. This layer should be at least 24 inches thick and should meet the LVC material criteria outlined in this report in section **Earthwork**. Where existing soils meet the LVC criteria, they should be moisture conditioned and recompacted as recommended in this report.
2. We recommend subgrades be maintained in a relatively moist condition until the floor slab is constructed. If the subgrade should become excessively wet or dry prior to construction of the floor slab, the affected material should be removed or the materials be scarified, moisture conditioned, and recompacted. Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab.

Item	Description
3.	If the purpose of this layer is solely to create a level base for concrete placement to maintain a more uniform slab thickness, well-graded sand, gravel or crushed stone can be used.
4.	If penetration of moisture vapor through the slab is a concern, in our opinion the floor slab design should include a capillary break layer in addition to a vapor retarder (refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of vapor retarders). In our opinion, capillary break layers should be comprised of granular materials that have less than 5 percent fines (material passing the #200 sieve). Other design considerations such as cold temperatures and condensation development could warrant additional design considerations.
5.	These granular materials may be considered part of the LVC zone.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to ACI 360, Guide to Design of Slabs-on-Ground. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy-duty concrete pavement and wet environments.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become excessively wet or dry or damaged prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations may occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after

construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation costs. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation costs. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, cost estimating, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

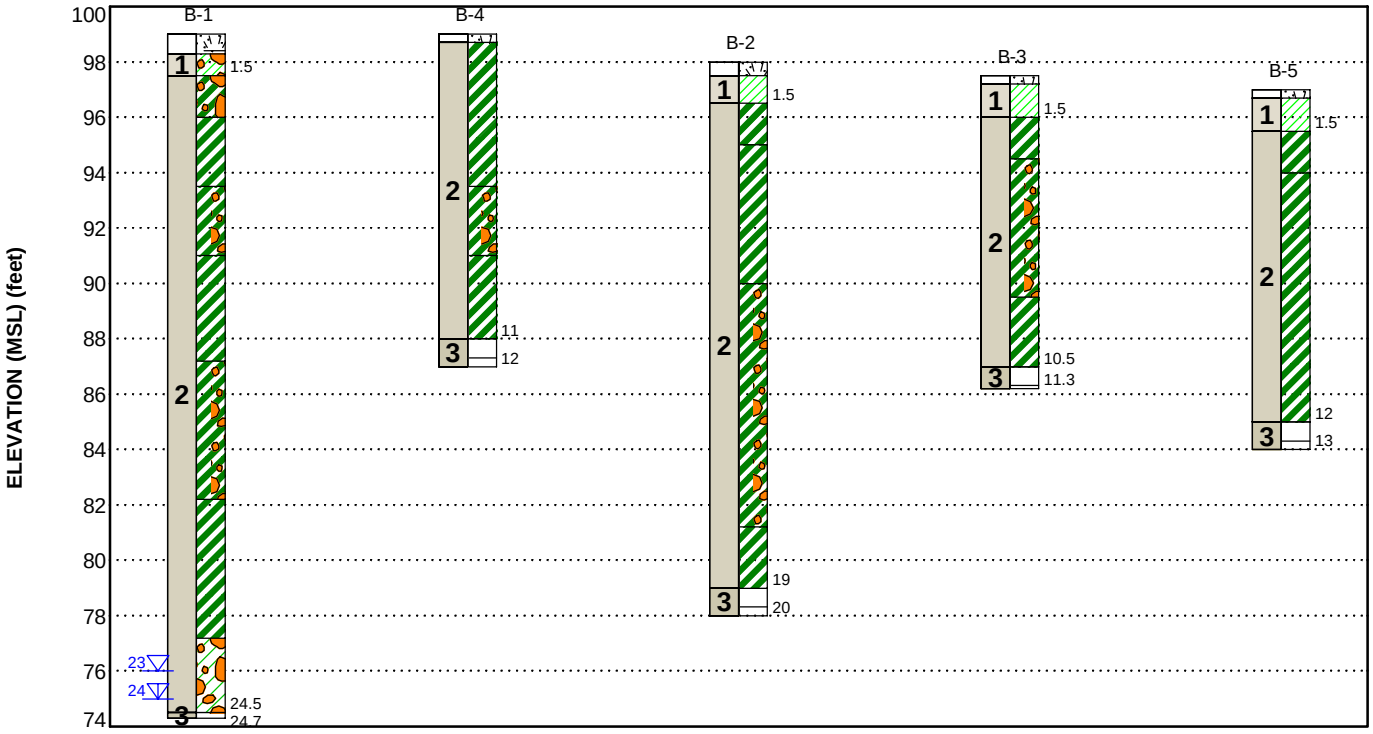
FIGURES

Contents:

GEOMODEL

Marshfield R-I School District Early Childhood Center ■ Marshfield, Missouri
Terracon Project No. B5215010

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Lean Clay**	Lean clay with varying amounts of gravel
2	**Fat Clay/Clayey Gravel**	Fat clay with varying amounts of gravel or clayey gravel
3	**Bedrock**	Dolomite

LEGEND

- Topsoil
- Gravelly Lean Clay
- Gravelly Fat Clay
- Fat Clay
- Fat Clay with Gravel
- Clayey Gravel
- Dolomite
- Lean Clay

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet) [1,2]	Planned Location
5	25 or auger refusal	building

1. Below ground surface
2. All borings, except B-1, encountered auger refusal on a possible cobble, boulder, or bedrock prior to their planned termination depth. All other borings extended to their planned depths.

Boring Layout and Elevations: The boring layout was performed by Terracon. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet). Approximate elevations were obtained by < surveyor's level and rod and are rounded to the nearest ½-foot. Elevations are referenced to a temporary benchmark (FFE of existing building) indicated on the **Site Location and Exploration Plan**. If more precise boring locations and elevations are desired, we recommend the borings be surveyed.

Subsurface Exploration Procedures: The borings were advanced with an ATV-mounted rotary drill rig using continuous flight, solid-stem augers. Samples were obtained in the borings as noted in **Exploration Results**. The split-barrel sampling procedure was performed using a standard 2-inch outer diameter, split-barrel sampling spoon that was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at their respective test depths. Water levels were observed and recorded during drilling and sampling. For safety purposes, all borings were backfilled with auger

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

Classification of the soil samples was performed in general accordance with the Unified Soil Classification System (USCS) based on the material's texture and plasticity. The project engineer

reviewed the field data and assigned laboratory tests to better understand the engineering properties of the various soil strata.

- Water (Moisture) Content of Soil and Rock by Mass
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils

SITE LOCATION AND EXPLORATION PLANS

Contents:

SITE LOCATION

Marshfield R-I School District Early Childhood Center ■ Marshfield, Missouri
March 16, 2021 ■ Terracon Project No. B5215010

Terracon GeoReport

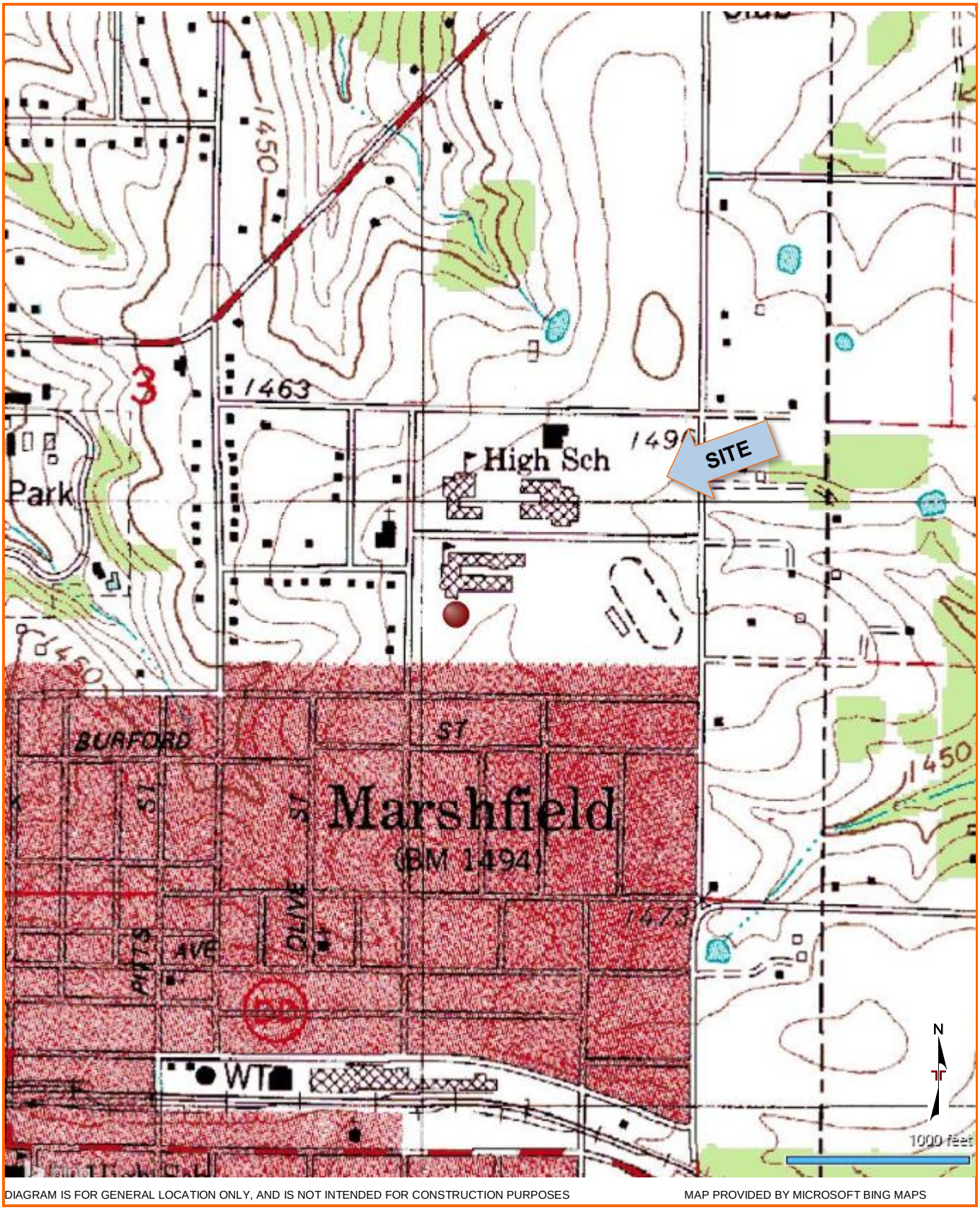


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

BORING LOCATION PLAN

Marshfield R-I School District Early Childhood Center ■ Marshfield, Missouri
March 16, 2021 ■ Terracon Project No. B5215010

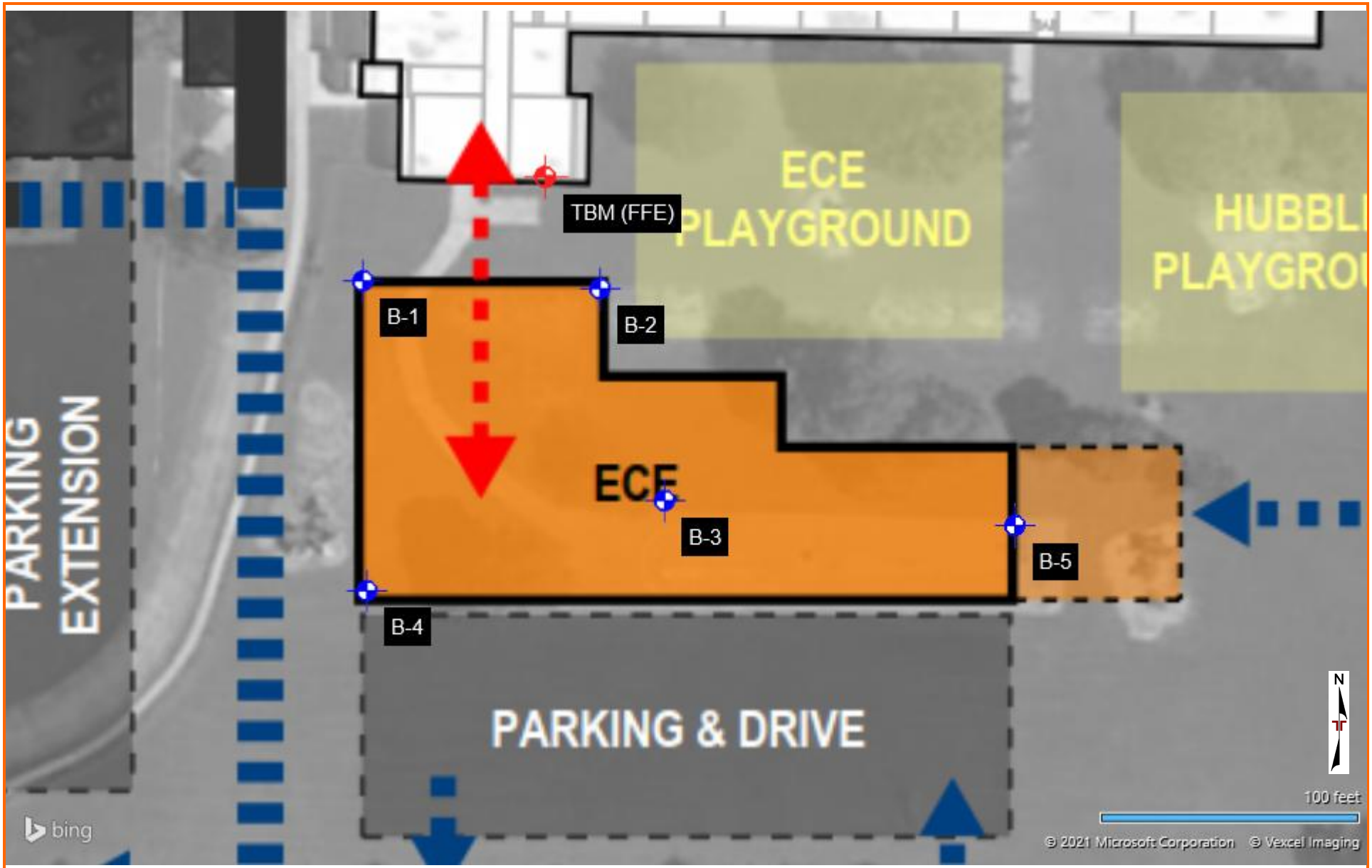


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH PRO

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH PRO

GEOLOGIC MAP

Marshfield R-I School District Early Childhood Center ■ Marshfield, Missouri
March 16, 2021 ■ Terracon Project No. B5215010

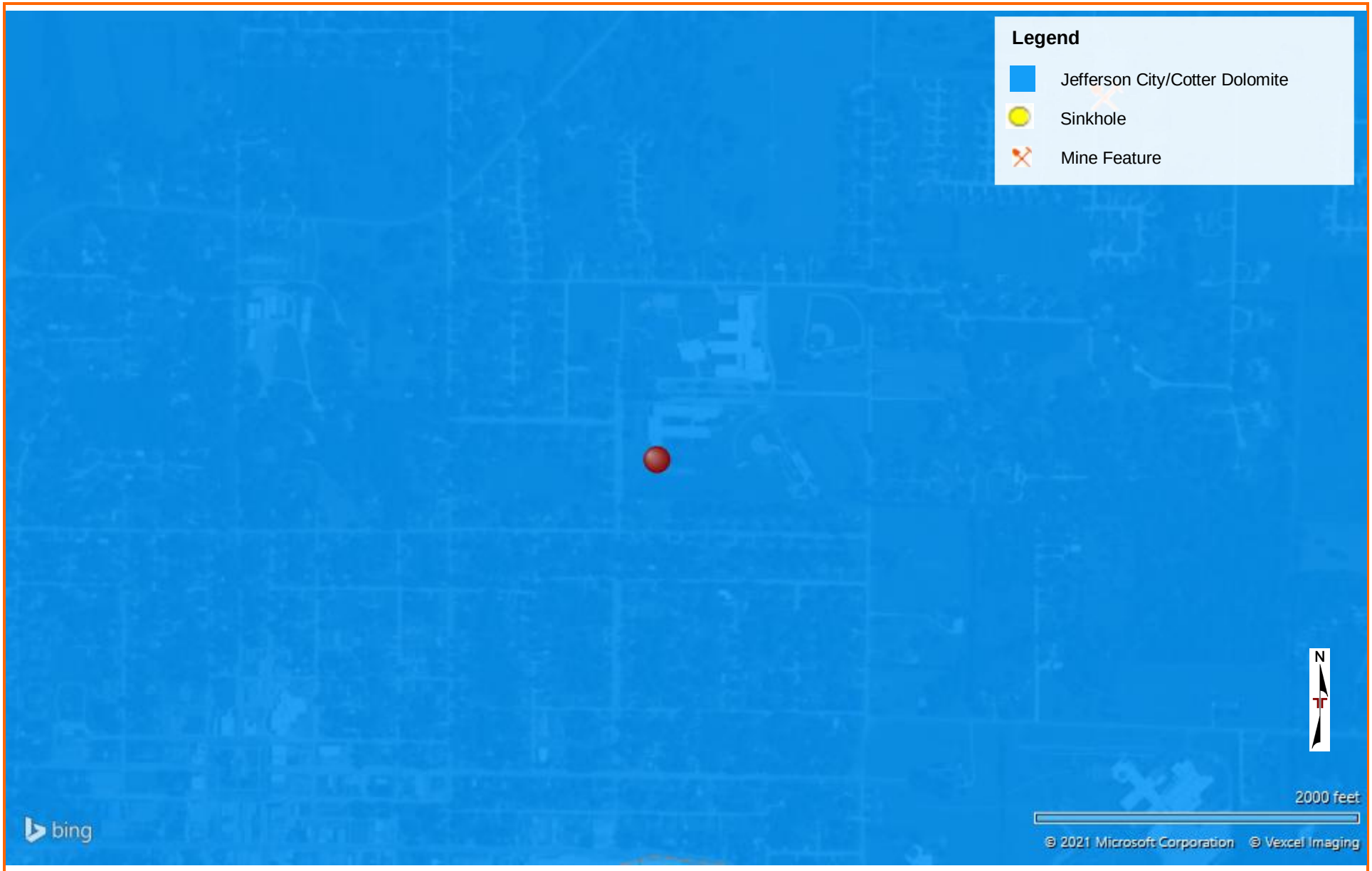


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE EARTH PRO

EXPLORATION RESULTS

Contents:

BORING LOG NO. B-1

PROJECT: Marshfield R-I School District Early Childhood Center

CLIENT: Paragon Architecture LLC
Springfield, Missouri

SITE: 600 N. Locust St.
Marshfield, Missouri

LOCATION See Exploration Plan

Latitude: 37.3440° Longitude: -92.8981°

Surface Elev.: 99 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		0.7	98.5								
		TOPSOIL									
1		1.5	97.5								
		GRAVELLY LEAN CLAY (CL), reddish brown to brown, medium stiff				X	16	3-3-4 N=7	3.25 (HP)	20.3	
		GRAVELLY FAT CLAY (CH), brownish red, medium stiff									
		3.0	96								
		FAT CLAY (CH), trace gravel, red, stiff				X	14	5-6-6 N=12	1.80 (HP)	20.2	74-16-58
		5.5	93.5	5							
		FAT CLAY WITH GRAVEL (CH), red, hard				X	8	21-30-15 N=45	2.25 (HP)	18.4	
		8.0	91								
		FAT CLAY (CH), trace gravel, red, very stiff				X	16	14-16-13 N=29	>4.50	36.3	
				10							
2		11.8	87								
		FAT CLAY WITH GRAVEL (CH), red, medium stiff				X	16	4-4-3 N=7	4.0 (HP)	34.8	
				15							
		16.8	82								
		FAT CLAY (CH), trace gravel, red, medium stiff				X	10	4-3-4 N=7	2.0 (HP)	38.6	
				20							
		21.8	77								
		CLAYEY GRAVEL (GC), red and gray, medium dense			▽						
		24.5	74.5		▽	X	9	12-15-50/2"	N/A	22.4	
3		24.7	74.5								
		DOLOMITE, moderately weathered									
		Auger Refusal at 24.7 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4.25" O.D. center fligh augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion and capped with hole plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

Notes:

Auger refusal encountered on possible cobble, boulder or bedrock at 24.7 feet.

WATER LEVEL OBSERVATIONS

▽ *While drilling*

▽ *At completion of drilling*

Terracon
4765 W Junction St
Springfield, MO

Boring Started: 03-03-2021 | Boring Completed: 03-03-2021

Drill Rig: CME 750X | Driller: DH

Project No.: B5215010

BORING LOG NO. B-2

PROJECT: Marshfield R-I School District Early Childhood Center

CLIENT: Paragon Architecture LLC
Springfield, Missouri

SITE: 600 N. Locust St.
Marshfield, Missouri

LOCATION See Exploration Plan

Latitude: 37.3439° Longitude: -92.8978°

Surface Elev.: 98 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		0.5	97.5								
		TOPSOIL									
1		1.5	96.5								
		LEAN CLAY (CL), trace gravel, reddish brown, medium stiff				X	13	3-4-3 N=7	2.0 (HP)	22.0	
		FAT CLAY (CH), trace gravel, brownish red, medium stiff									
		3.0	95			X	9	4-4-7 N=11	1.75 (HP)	22.8	
		FAT CLAY (CH), trace gravel, red, stiff		5							
						X	18	4-6-8 N=14	3.0 (HP)	32.7	
		8.0	90								
2		**FAT CLAY WITH GRAVEL (CH)**, red, soft to very stiff				X	10	11-8-7 N=15	3.25 (HP)	28.9	
				10							
						X	10	3-1-1 N=2	1.25 (HP)	35.3	
				15							
		16.8	81								
		FAT CLAY (CH), trace gravel, red, soft									
		19.0	79			X	6	2-50/0"	1.0 (HP)	31.5	
3		**DOLOMITE**, q, moderately weathered									
		20.0	78	20							
		Auger Refusal at 20 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4.25" O.D. center fligh augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion and capped with hole plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

Notes:

Auger refusal encountered on possible cobble, boulder or bedrock at 20 feet.

WATER LEVEL OBSERVATIONS

Not observed while drilling

Terracon
4765 W Junction St
Springfield, MO

Boring Started: 03-03-2021 | Boring Completed: 03-03-2021

Drill Rig: CME 750X | Driller: DH

Project No.: B5215010

BORING LOG NO. B-3

PROJECT: Marshfield R-I School District Early Childhood Center

CLIENT: Paragon Architecture LLC
Springfield, Missouri

SITE: 600 N. Locust St.
Marshfield, Missouri

LOCATION See Exploration Plan

Latitude: 37.3437° Longitude: -92.8977°

Surface Elev.: 97.5 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		0.3	97								
		TOPSOIL									
1		1.5	96								
		LEAN CLAY (CL), trace gravel, reddish brown, medium stiff				X	11	3-4-3 N=7	2.25 (HP)	20.6	
		3.0	94.5								
		FAT CLAY (CH), trace gravel, brown and red, medium stiff				X	10	7-11-13 N=24	2.50 (HP)	20.0	
2		**FAT CLAY WITH GRAVEL (CH)**, red, medium stiff to very stiff		5		X	11	4-2-3 N=5	1.20 (HP)	40.4	
		8.0	89.5								
		FAT CLAY (CH), trace gravel, red, stiff				X	10	3-6-5 N=11	1.0 (HP)	40.4	
		10.5	87	10							
3		11.3	86								
		Auger Refusal at 11.3 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4.25" O.D. center fligh augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion and capped with hole plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

Notes:

Auger refusal encountered on possible cobble, boulder or bedrock at 11.3 feet.

WATER LEVEL OBSERVATIONS

Not observed while drilling

Terracon
4765 W Junction St
Springfield, MO

Boring Started: 03-03-2021	Boring Completed: 03-03-2021
Drill Rig: CME 750X	Driller: DH
Project No.: B5215010	

BORING LOG NO. B-4

PROJECT: Marshfield R-I School District Early Childhood Center

CLIENT: Paragon Architecture LLC
Springfield, Missouri

SITE: 600 N. Locust St.
Marshfield, Missouri

LOCATION See Exploration Plan

Latitude: 37.3436° Longitude: -92.8981°

Surface Elev.: 99 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		0.3	98.5								
		TOPSOIL									
2		**FAT CLAY (CH)**, trace gravel, red, medium stiff to very stiff				X	12	3-4-3 N=7	2.25 (HP)	23.1	
						X	9	4-6-10 N=16	3.25 (HP)	24.5	
		5.5	93.5	5							
		FAT CLAY WITH GRAVEL (CH), red, stiff				X	11	8-5-9 N=14	3.5 (HP)	33.4	
		8.0	91								
		FAT CLAY (CH), trace gravel, red, stiff				X	14	7-6-5 N=11	2.30 (HP)	29.9	
		11.0	88	10							
3		**DOLOMITE**, moderately weathered									
		12.0	87								
		Auger Refusal at 12 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4.25" O.D. center fligh augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion and capped with hole plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

Notes:

Auger refusal encountered on possible cobble, boulder or bedrock at 12 feet.

WATER LEVEL OBSERVATIONS

Not observed while drilling

Terracon
4765 W Junction St
Springfield, MO

Boring Started: 03-03-2021	Boring Completed: 03-03-2021
Drill Rig: CME 750X	Driller: DH
Project No.: B5215010	

BORING LOG NO. B-5

PROJECT: Marshfield R-I School District Early Childhood Center

CLIENT: Paragon Architecture LLC
Springfield, Missouri

SITE: 600 N. Locust St.
Marshfield, Missouri

LOCATION See Exploration Plan

Latitude: 37.3437° Longitude: -92.8972°

Surface Elev.: 97 (Ft.)

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
		0.3	96.5								
		TOPSOIL									
1		1.5	95.5								
		LEAN CLAY (CL), brown, medium stiff				X	6	3-3-2 N=5	1.20 (HP)	22.3	
		FAT CLAY (CH), trace gravel, brownish red, medium stiff									
		3.0	94								
		FAT CLAY (CH), trace gravel, red, medium stiff to very stiff				X	8	3-3-4 N=7	1.25 (HP)	23.6	
				5							
2						X	16	3-6-6 N=12	4.0 (HP)	25.5	61-21-40
						X	10	8-13-13 N=26	3.25 (HP)	32.0	
				10							
		12.0	85								
3		**DOLOMITE**, moderately weathered									
		13.0	84								
		Auger Refusal at 13 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
4.25" O.D. center fligh augers

Abandonment Method:
Boring backfilled with auger cuttings upon completion and capped with hole plug.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were measured in the field using an engineer's level and grade rod.

Notes:

Auger refusal encountered on possible cobble, boulder or bedrock at 13 feet.

WATER LEVEL OBSERVATIONS

Not observed while drilling

Terracon
4765 W Junction St
Springfield, MO

Boring Started: 03-03-2021 | Boring Completed: 03-03-2021

Drill Rig: CME 750X | Driller: DH

Project No.: B5215010

SUPPORTING INFORMATION

Contents:

GENERAL NOTES

SAMPLING	WATER LEVEL	FIELD TESTS
Rock Core  Split Spoon	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** Standard Penetration Test Resistance (Blows/Ft.) **(HP)** Hand Penetrometer **(T)** Torvane **(DCP)** Dynamic Cone Penetrometer **UC** Unconfined Compressive Strength **(PID)** Photo-Ionization Detector **(OVA)** Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (psf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		**PLASTICITY DESCRIPTION**	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.