SPECIFICATIONS and PROJECT MANUAL

FOR THE CONSTRUCTION
OF

PROJECT WHALE

MULTI-STORY
G+4.5 MEDIUM GEN 11.5T

DEVELOPER

SEEFRIED
INDUSTRIAL PROPERTIES

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MAA PROJECT # 2021-136
ISSUED 01/21/2022

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END OF SECTION 00 0110

SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: PROJECT WHALE

B. Tenant's Design Criteria: Design Criteria AR Sortable - Multi-Story-Prototype V3.00, dated 09/14/2021- Relates the Tenant's overall project intented direction and is to be included as reference to this project specification.

C. The Work will be constructed under a single prime contract.

1.02 WORK FURNISHED BY THE TENANT UNDER SEPARATE CONTRACTS

A. The Tenant will award separate contracts for the performance of certain construction operations at the site. Those operations will be conducted simultaneously with work under this Contract. Those contracts include the following:
   1. Mechanized Conveyor System
   2. Material Handling Equipment
   3. Battery Chargers and Racking
   4. Pallet Racking
   5. Office Furniture
   6. Interior Floor Striping
   7. Warehouse Storage ID Signage
   8. Column Protectors
   9. A/V Equipment

B. Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract.

C. Permanent lighting shall be operational when the racking and material handling equipment installation is scheduled, so that adequate lighting is provided in all areas where work will be carried out. Contractor shall be responsible for these utility costs until Date of Substantial Completion.

D. Contractor shall provide access to the building for Tenant's contractor to perform work.

E. Tenant’s vendors, suppliers, and installers shall be responsible for obtaining required permits for their work.

1.03 OWNER CONTRACTED COMMISSIONING

A. Per specification 01 9113 - General Commissioning Requirements, the Owner will contract with a commissioning provider (CxP).

B. Contractor is to coordinate with the CxP as described in the specification.

C. Contractor to incorporate issues reported by CxP into ongoing corrections and include as a portion of Final Correction Punch List.

1.04 CONTRACTOR USE OF PREMISES

A. General: During the entire construction period, the Contractor shall coordinate use of the site with all work being performed under separate contracts
   1. Use of the Site: Confine operations at the site to the areas required for performance of the contract.
   2. Do not encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to areas designated by the Owner.
   3. Smoking or open fires will not be permitted within the building enclosures.

1.05 OWNER OCCUPANCY

A. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building, prior to Substantial Completion provided that

such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the Work.

1. Obtain a Certificate of Occupancy from local building officials prior to partial Owner occupancy if required.
2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational when applicable. Required inspections and tests shall have been successfully completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 01 2000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less applicable taxes.

B. Architect Responsibilities:
   1. Select products in consultation with Owner and transmit decision to Contractor.

C. Contractor Responsibilities:
   1. Assist Architect in selection of products, suppliers, and installers.
   2. Obtain proposals from suppliers and installers and offer recommendations.
   3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
   4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
   5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.

D. Differences in costs will be adjusted by Change Order.

1.04 ALLOWANCES SCHEDULE

A. $250,000 for Tenant Power Usage from 1st Access to TCO

B. $500,000 for RSP Grinding

C. $2,000,000 for IT

D. $1,250,000 for Security

E. $450,000 for Tenant Temporary Toilets

F. $700,000 for Tenant Dumpsters

G. $250,000 for MHE Sprinkler Head

H. $200,000 for Scanning for Floor Curvature

I. $1,200,000 for Covid

J. $400,000 for BIM

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2200
UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. List of unit prices, for use in preparing Bids.

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

1.02 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.

1.03 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.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities will be verified by Owner.

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

1.05 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.

1.06 SCHEDULE OF UNIT PRICES.

A.	Installed 42 inch high guardrail at mezzanine.	$ per l.f.
B.	Fire extinguishers per unit installed cost.	$ each
C.	Installed duplex receptacle in office area.	$ each
D.	Installed voice/data box in office area.	$ each
E.	Installed Type N light fixture in warehouse area.	$ each
F.	Installed Type N1 light fixture in warehouse area.	$ each
G.	Installed Type N2 light fixture in warehouse area.	$ each
H.	Dumpster Pull for Tenant's Vendors Trash	$per pull
I.	Site Light Pole - Single Head	$each
J.	Site Light Pole - Double Head	$each
K.	Site Light Pole - Quad Head	$each
L.	Remove and replace a panel of interior slab-on-grade (between CJ's)	$each
M.	Installed warehouse duplex outlet w/ 250' power feed to nearest circuit	$each
N.	Installed warehouse quad outlet w/ 250' power feed to nearest circuit	$each
O.	3/4" warehouse conduit drop for data - full height	$each
P.	Installed sprinkler head under conveyor	$per head
Q.	Remove 9'x10' conc knock-out and install 9'x10' storefront (mark 1)	$each
R.	Remove 9'x10' conc knock-out and install 9'x10' storefront (mark 3)	$each

S.	Bolt down bollard.	$each
T.	Prefabricated 42" high highway guardrail.	$per l.f.
U.	General Conditions.	$ per day

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for pricing Alternates.

B. Documentation of changes to Contract Sum and Contract Time.

1.02 ACCEPTANCE OF ALTERNATES

A. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.

B. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

C. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

A. Number 1 - Provide an add or deduct for the second 270,000 gallon fire protection tank.

B. Number 2 - Provide an add for a sixth 4,000a electrical service

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preconstruction meeting.
B. Progress meetings.
C. Pre-Slab Meeting.
D. Structural Construction Observation Milestones.
E. Pre-Roof Meeting.
F. Progress photographs.
G. Webcam service.
H. Submittals for review, information, and project closeout.
I. Number of copies of submittals.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
B. Section 01 7800 - Closeout Submittals: Project record documents.
C. Section 01 9113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

A. Contractor will schedule a meeting within 15 days of date established in Notice to Proceed.
B. Attendance Required:
   1. Owner.
   2. Owner's Representative.
   3. Architect.
   4. Contractors Project Manager and Superintendent.
   5. Major Subcontractors.
   6. Testing Agency.
   7. Others as appropriate.
C. Agenda:
   1. Project Coordination: Designation of responsible personnel.
   2. Distribution of Contract Documents.
   3. Submission of list of Subcontractors, schedule of values, and progress schedule.
   4. Major equipment deliveries and priorities.
   5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   6. Procedures for testing and inspection.
   7. Use of premises:
      a. Jobsite trailers, work and storage areas.
      b. Owner's requirements.
   8. Temporary utilities.
   9. Safety and first-aid procedures.
   10. Security procedures.
   11. Housekeeping procedures.
   12. Scheduling.

13. Scheduling activities of Testing Agency.

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.

3.02 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly 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 off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. 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.

3.03 PRE-SLAB MEETING:

A. Schedule and administer pre-slab meeting 14 days prior to placing floor slabs.

B. Attendance Required:
1. Owner's Representative.
2. Architect.
3. Structural Engineer
4. Material Testing Agency's Field Representative.
5. Concrete Consultant.
6. Contractor's Project Manager and Superintendent.
7. Concrete Finishing Subcontractor.
8. Concrete Supplier.
9. Others as appropriate.

C. Suggested Agenda:
1. Subgrade preparation.
2. Formwork.
3. Sequencing of slab pours.
4. Concrete mix designs.
5. Admixtures (if any).
6. Slump - Adding water at site.
7. Reinforcement (if any).
8. Doweling of construction joints.
9. Placing and finishing procedures.
10. Sawing of control joints.

11. Curing procedure.
12. Testing procedures - concrete.
13. Testing procedures - flatness and levelness.
14. Weather conditions and precautions.
15. Protection of floor slabs:
    a. Edge breakage at temporary ramps.
    b. Anchorage of tilt panel forms and reveals.
    c. Scratching/ marring of slab during tilt panel construction and erection.
    d. Repair of tilt panel bracing bolt holes.
    e. Oil staining by follow-on trades.
    f. Spalling of floor joints.
16. Slab joint fill procedures.
17. Procedure to follow if problems are encountered.

3.04 PRE-ROOFING MEETING:

A. Schedule and administer pre-roof meeting 14 days prior to commencing installation of roofing.

B. Attendance Required:
1. Owner's Representative.
2. Architect.
3. Contractor's Project Manager and Superintendent.
4. Roofing sub-contractor.
5. Roofing membrane manufacturer.
6. Others as appropriate.

C. Suggested Agenda
1. Discuss representative areas of roofing substrates; inspect and discuss condition of substrate, scupper preparations, curbs, penetrations, and other preparatory work performed by other trades.
2. Review structural loading limitations of deck and inspect deck for flatness and for required mechanical fastening.
3. Review roofing system requirements: Drawings, Specifications, and other Contract Documents.
4. Review required submittals, both complete and incomplete.
5. Review preliminary roof inspection reports verifying locations and heights of roof drains, overflow scuppers, sloping of roof deck, and other roof components.
6. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
7. Review required inspection, testing, certifying, and material use accounting procedures.
8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing, and provision of watertight cut-offs.

3.05 CONSTRUCTION OBSERVATION MILESTONES:

A. Contractor to notify Architect 7 days prior to the following construction activities:
1. Beginning installation of the metal roof deck including perimeter decking.
2. 100% completion of all structural elements.
3. Notification when the first fire sprinkler zone overhead piping is completed.
4. Notification of date to conduct fire pump acceptance test.
5. Office area rough-in of mechanical, plumbing and electrical work prior to closing up walls and ceilings.

3.06 PROGRESS PHOTOGRAPHS

A. Photography Type: Digital; electronic files.

B. Take photographs that apply to work under construction and submit promptly to Owner.

1. Completion of site clearing.
2. Excavations in progress.
3. Foundations in progress and upon completion.
4. Site utilities, particularly underground fireline and thrust blocks.
5. Slab placements in progress.
6. Structural framing in progress and upon completion.
7. Enclosure of building, upon completion.

C. Aerial Views:
1. Provide aerial photographs from four cardinal views monthly.

D. Drone Video:
1. Recording of the monthly construction progress.

E. Digital Photographs: 24 bit color, minimum resolution of 1600 by 1200 ("2 megapixel"), in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 4 photos per page, each photo labeled with file name; one PDF file per submittal.

3.07 WEBCAM SERVICE

A. Provide a webcam service - OxBlue or equal. Webcam to be on a fixed pole in a location approved by the Owner. Remove pole once service is terminated at project completion.

3.08 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
1. Product data.
2. Shop drawings.
3. Samples for selection.
4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only 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 01 7800 - Closeout Submittals.

E. Job delays occasioned by requirement of resubmission of samples, shop drawings and product data not in accord with Contract Documents are Contractor's responsibility and will not be considered valid justification for extension of contract time.

F. Commence no portion of work requiring submittals until submittal has been reviewed by Architect.

3.09 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:
1. Operation and maintenance data.
2. Warranties.
3. Other types as indicated.

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

3.10 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review:

1. It is preferable to submit one electronic copy in PDF format in lieu of hard copies. An electronically-marked up file will be returned. Create PDF's at native size and right-side up. Illegible files will be rejected.
2. If hard copies are submitted, submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.

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.

C. Documents for Project Closeout: Provide an electronic copy in PDF format of all reviewed submittals. See Section 01 7800 Project Closeout.

3.11 SUBMITTAL PROCEDURES

A. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.

B. Transmit each submittal with a copy of approved submittal form.

C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. 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.

F. Schedule submittals to expedite the Project, and coordinate submission of related items.

G. For each submittal for review, allow 14 days excluding delivery time to and from the Contractor.

H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

I. Provide space for Contractor and Architect review stamps.

J. When revised for resubmission, identify all changes made since previous submission.

K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References and standards.

B. Control of installation.

C. Testing and inspection agencies and services.

D. Control of installation.

E. Manufacturers' field services.

F. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

C. Section 01 9113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.

D. Sections listing individual testing requirements.

1.03 REFERENCE STANDARDS

A. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

B. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry.

C. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

E. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing.

1.04 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
   1. Soils compaction.
   2. Paving (Concrete/Asphalt)
   3. Concrete Testing and Placement, (including Tilt-Up Wall Panels).
   4. Foundations
   5. Reinforcing steel.
   6. Floor flatness and levelness.
   7. Masonry
   8. Structural steel welds.
   9. Structural bolts.
   10. Metal deck attachments.

B. Owner shall employ and pay for services of an independent Roofing Consultant to review roof submittals, attend pre-roofing meeting, provide on-site inspections (minimum of 1 trip per week) and provide Punch List. Inspections shall be performed by a Registered Roof Observer (RRO) as recognized by the Roofing Consultants Institute.

C. As indicated in individual specification sections, Owner shall employ and pay for services of an independent testing agency to perform other specified testing.

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

E. Testing Agency Requirements:
   1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
   2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
   3. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.
      a. Specific testing equipment as described in individual sections.
   4. Reports of all tests shall be signed by a qualified individual, having professional registration in the state in which the project is being constructed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 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.

3.02 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Attend preconstruction meetings and progress meetings as required.
   7. Testing Agency shall promptly process and distribute all copies of test reports and related instructions to insure that all necessary retesting and/or replacement of materials can be accomplished without possible delay to progress of the work. The Testing Agency shall provide a written report within three (3) days related to every project test and inspection. Distribute copies to each of the following:
      a. Owner
      b. Architect
      c. Structural Engineer
      d. Contractor
      e. Building Official (if required)

B. 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.

C. 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. Provide Testing Agency with copies of the following shop drawings prior to start of work:
   a. Asphalt mix designs.
   b. Concrete mix designs.
   c. Masonry grout/mortar mix designs.
   d. Structural including steel, reinforcing, masonry.
   e. Roofing shop drawings.
3. Cooperate with laboratory personnel, and provide access to the Work .
4. 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.
5. Notify the Testing Agency a minimum of 48 hours in advance of operations to allow for Testing Agency assignment of personnel and scheduling of tests.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.03 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 of 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.

3.04 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

END OF SECTION

SECTION 01 4540

CONCRETE TESTING - RANDOM TRAFFIC AREAS FLOOR FLATNESS AND LEVELNESS TESTING (FF - FL)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes testing and reporting requirements for random traffic floor areas.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 03 3000 - Cast-in-Place Concrete

C. Section 03 3560 - Concrete Floor Finishing

1.03 REFERENCE STANDARDS

A. The referenced standards are to be the latest editions adopted at project bid date.
   1. ASTM E1155 - Standard Test Method for Determining Ff Floor Flatness and Fl Floor Levelness Numbers

1.04 DEFINITIONS

A. The definitions are to be per ASTM E1155, except as follows:
   1. Test Surface: The entire bay of continuous concrete slab placement.
   2. Test Section: The subdivision of the test surface where sample measurement lines are used to collect data for the slab's test surface.

B. Specified overall values (SOV): The composite values of all F-Numbers for the test sections of a test surface.

C. Minimum local values (MLV): The minimum F-Number values permitted for an individual test section.

1.05 SUBMITTALS

A. Evidence of Qualifications:
   1. Provide a certificate verifying the person performing the work is a certified technician for the floor surface measuring equipment to be used.
   2. Testing personnel to have a minimum of 3 years of floor surface testing experience. Submit list of 3 recently completed projects similar in complexity and include project address along with Architect, Structural Engineer, and Contractor's names and telephone numbers.

B. Equipment:
   1. Provide floor surface measuring equipment data sheets.
   2. Provide plan of action if floor surface measuring equipment is defective or inoperative.

C. Proposed test sections: After attending the Slab Pre-Construction Meetings and the submission of the contractor's slab placement plan, provide floor plan drawing showing the proposed test sections and sample measurement line locations for the concrete slab placements. Submit information a minimum of three days prior to slab placement.

D. Report requirements: The reports are to include as a minimum the following information:
   1. The reporting requirements of ASTM E1155
   2. Floor plan drawing showing the boundary limits of each test section with the sample measurement lines numbered and their locations identified on the plan. The plan should be sufficiently accurate to allow the testing to be replicated and data to be verified if necessary.
   3. A plot of the slab surface profile elevation as a function of horizontal distance for each sample measurement line.
   4. The listing of the maximum (+ and -) q value (profile curvature value) for each sample measurement line, along with the location.

5. Locations of floor test sections that are deficient are to be shown on the floor plan drawing.
6. The statistical amount of floor test surface area that is not in compliance with the specified SOV.

E. Report scheduling:
1. Submit written report by electronic means or hand deliver to parties concerned within 36 hours, or next regularly scheduled working day, after placement. Weekends and holidays are to be ignored when computing the testing and reporting deadlines. Include cost for retesting replaced or repaired defective areas.
   a. Retesting required because of non-conformance to specified requirements shall be performed by the same testing agency. Payment for retesting will be charged to the Contractor by deducting testing charges from the Contract Price.

F. Notifications:
1. Immediately notify preferably in less than 1 hour the Owner's representative and other parties concerned if any test section does not meet the MLV.
2. Immediately notify preferably in less than 1 hour the Owner's representative and other parties concerned if any test surface does not meet the SOV.
3. Complete testing to identify defective areas and give verbal report to Owner's representative and other parties concerned within 24 hours after placement.

1.06 QUALITY ASSURANCE

A. Testing requirements:
1. Measure random traffic areas delineated on the drawings per ASTM E1155 with the following exceptions:
   a. Sample measurement lines are to occur for floor areas within 2 feet of construction joints and columns.
2. Ensure 25% to 50% of the sample measurement lines are within 18" of the column lines.
3. F-Number Requirements: As noted on drawings or specifications.

B. Additional testing requirements: Measure designated items as noted in specification.

C. Owner's testing agency is neither authorized to change any specified requirement, approve any portion of Work, nor reject Work.

D. Responsibilities and duties of Contractor relative to Owner's testing:
1. Notify Owner's testing agency in advance of slab's pre-construction meeting to allow sufficient time to attend meeting.
2. Notify Owner's testing agency in advance of concrete placement to allow sufficient time to prepare for required testing.

E. Cost Responsibility: Costs for corrective work and extra testing required by defective work borne by Contractor.

F. Slab Pre-Construction Meetings:
1. Personnel who are to perform the actual testing and those who have authority to control Work are required to attend the slab's pre-construction meetings.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. F-Numbers
1. Floor surface measuring device is to be able to measure the floor surface elevation change over 12 in. with an accuracy tolerance that does not exceed +/- 0.002 in.
2. Approved Equipment:
   a. The Face Companies "Dipstick"
   b. Allen Face "D-Meter"
   c. Somero Matson Group "SMG Axiom 1155"

B. Spot Elevations Changes
1. Approved Equipment:

a. Humboldt Concrete Displacement Monitor
b. M-D 24" SmartTool
c. M-D 24" SmartTool w/ADA Slope Walker
d. Johnson Electronic Digital Box Level 24-Inch
e. Bosch Digital Level, 24 Inch
f. The Face Companies “Dipstick”
g. Allen Face “D-Meter”
h. Somero Matson Group “SMG Axiom 1155”

PART 3 - EXECUTION

3.01 GENERAL

A. Start testing sections as soon as possible as they become available after final troweling operations so as not to impede the slab curing process. The testing should be done sooner but shall not exceed 72 hours after completion of the slab concrete finishing operations for the area being tested.

B. For suspended slabs that have a specified FL value, testing is to occur before removable forms and/or shores have been removed.

3.02 TEST SECTION DIMENSIONS

A. Test section areas are to satisfy all the following:
1. A minimum of 5 test sections are to be used for a test surface that exceeds 2000 sf.
2. Conform to ASTM E1155 for the smallest permitted test section.
3. Test section is not to exceed 14,500 sf.
4. Test sections to be bound by construction joints, column or half-column lines.
5. Orient sample measurement lines parallel and perpendicular to column lines, not diagonally oriented.

3.03 ADDITIONAL TESTING REQUIREMENTS

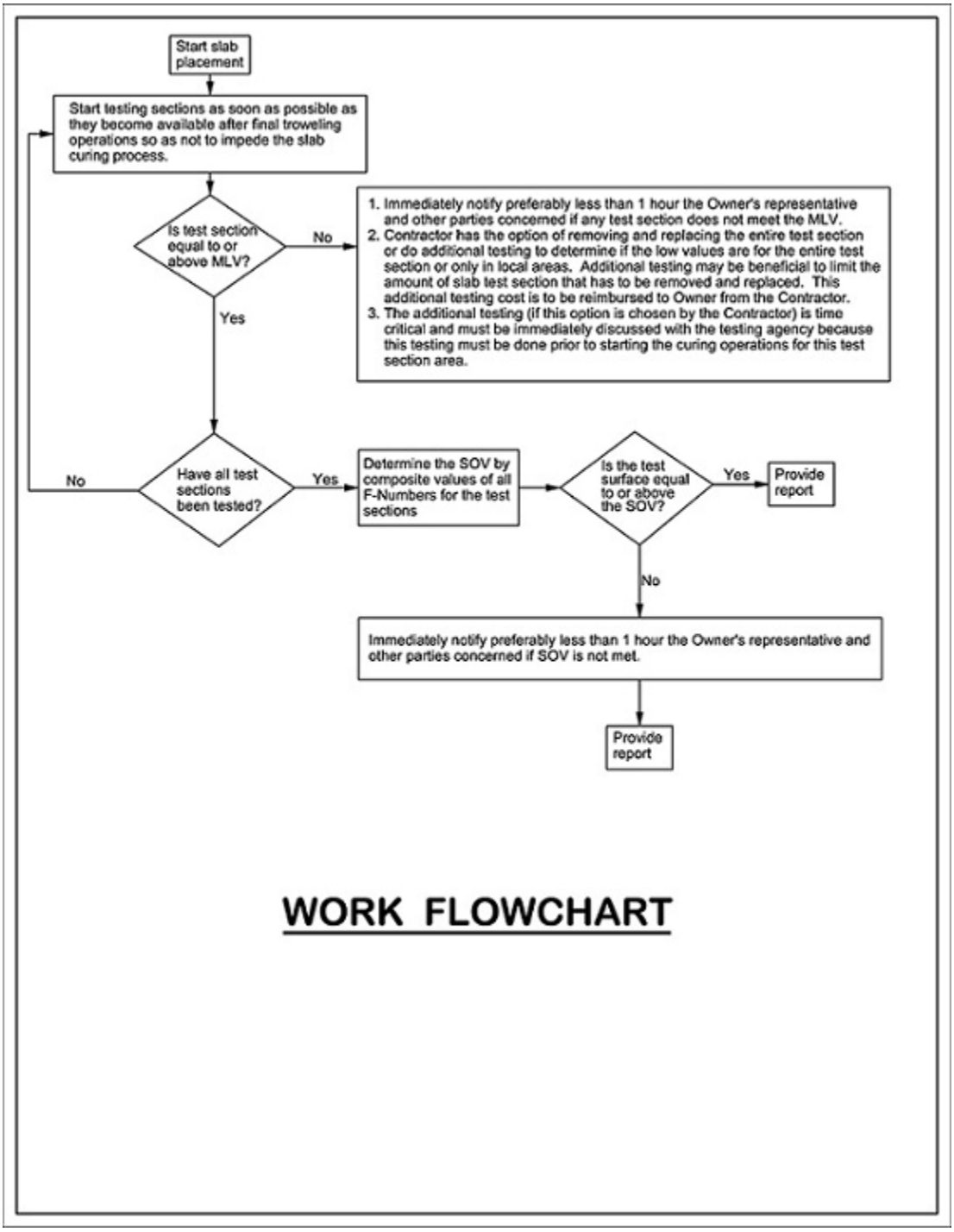
A. The additional testing is to be done within 72 hours after completion of the slab concrete finishing operations for the area being tested.

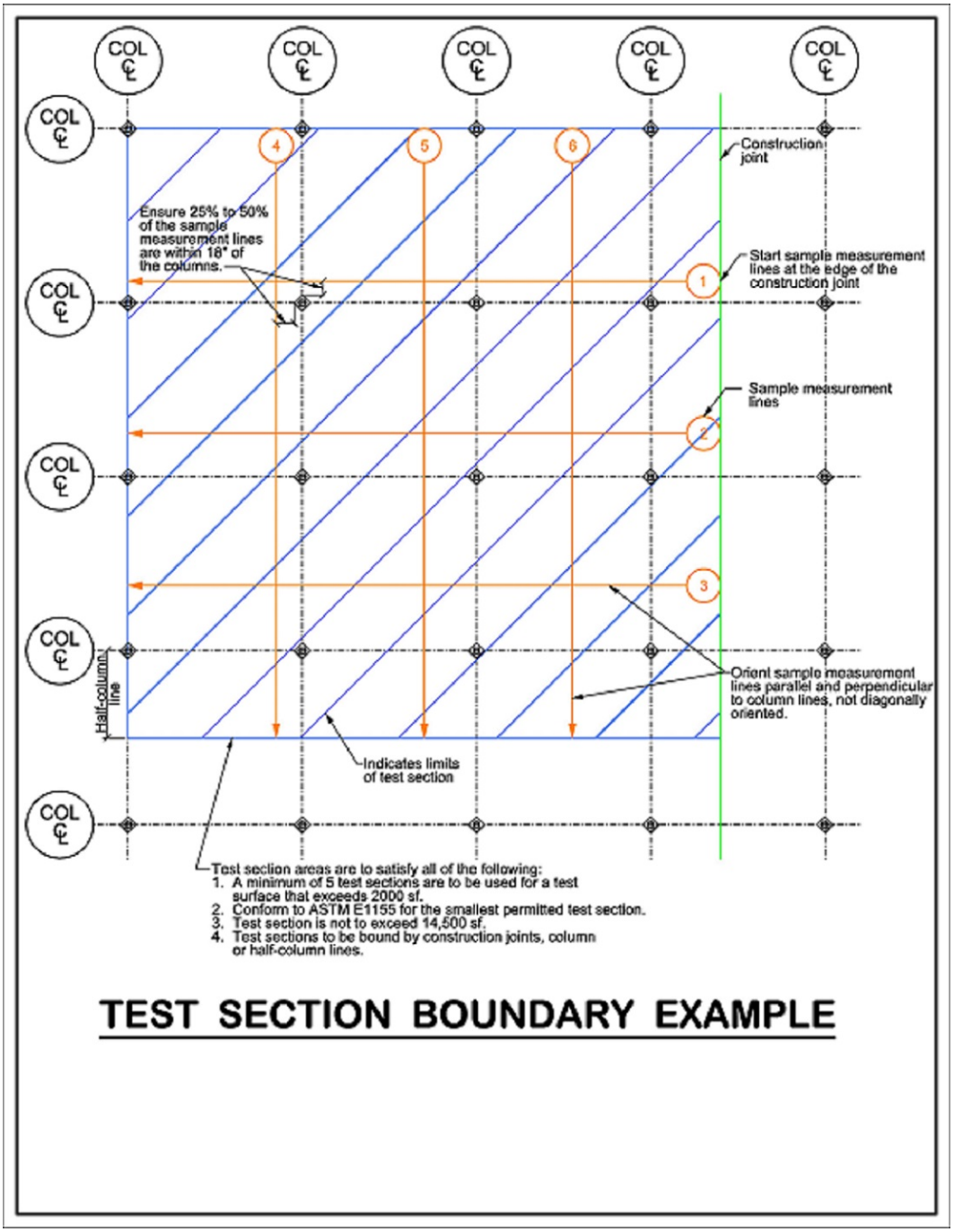
B. See attachment Additional Testing Requirements for testing locations.
1. Additional sample measurement lines are to be made adjacent to RSP Fence Boundary. Coordinate location of sample measurement lines with Tenant’s Construction Manager. Testing values at these sample measurement lines are to be reported and evaluated separately and are not to be included in the determination of the floor’s FF Floor Flatness and FL Floor Levelness values.
2. Spot elevation change measurements
   a. Requirement: Note on drawing and list locations in tabular form where the elevation change exceeds ¼” over 2’-0” along with the slope’s angle.
   b. Locations:
      1) All four sides of each column
      2) All four sides of floor openings at a maximum 2’-0” spacing.
      3) All four sides of floor penetrations
      4) Along the floor expansion joints on both sides at a maximum 10’-0” spacing.
      5) Any other locations as directed by the Tenant’s Construction Manager.

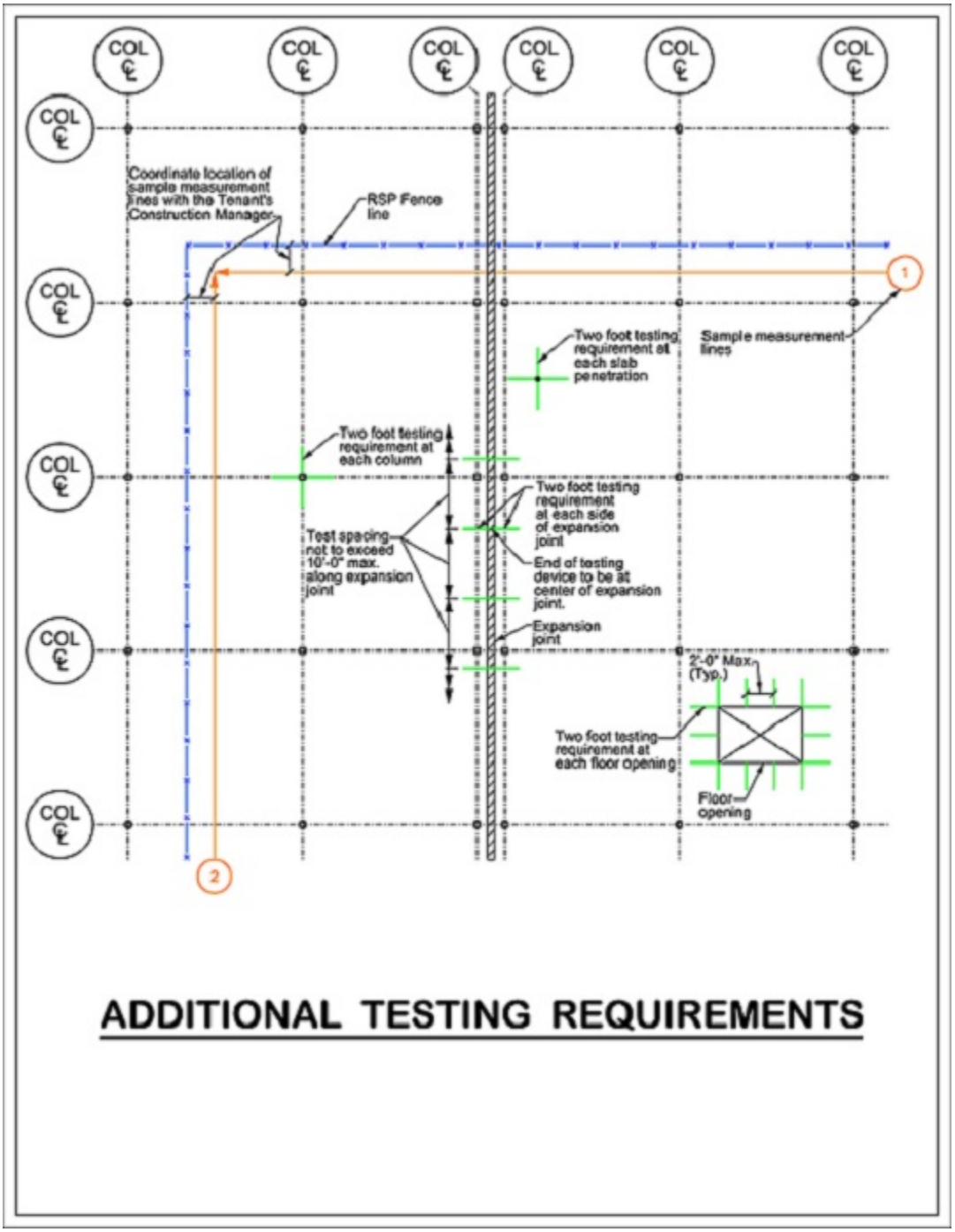
C. Measure and report on drawing and list locations in tabular form vertical step transitions that exceed 120 mils (0.120 in.) adjacent to expansion joint after expansion joint installation. Make measurements at other locations as directed by the Tenant’s Construction Manager.

3.04 ATTACHMENTS

A. The following attachments are part of this Section:
1. Work Flowchart
2. Test section boundary example
3. Additional Testing Requirements


Start slab placement
Start testing sections as soon as possible as they become available after final troweling operations so as not to impede the slab curing process.
Is test section equal to or above MLV?
No
1. Immediately notify preferably less than 1 hour the Owner's representative and other parties concerned if any test section does not meet the MLV.
2. Contractor has the option of removing and replacing the entire test section or do additional testing to determine if the low values are for the entire test section or only in local areas. Additional testing may be beneficial to limit the amount of slab test section that has to be removed and replaced. This additional testing cost is to be reimbursed to Owner from the Contractor.
3. The additional testing (if this option is chosen by the Contractor) is time critical and must be immediately discussed with the testing agency because this testing must be done prior to starting the curing operations for this test section area.
Yes
Have all test sections been tested?
No
Yes
Determine the SOV by composite values of all F-Numbers for the test sections
Is the test surface equal to or above the SOV?
Yes
Provide report
No
Immediately notify preferably less than 1 hour the Owner's representative and other parties concerned if SOV is not met.
Provide report
WORK FLOWCHART


COL ℄
Construction joint
Ensure 25% to 50% of the sample measurement lines are within 18" of the columns.
Start sample measurement lines at the edge of the construction joint
Sample measurement lines
Orient sample measurement lines parallel and perpendicular to column lines, not diagonally oriented.
Half-column line
Indicates limits of test section
Test section areas are to satisfy all of the following:
1. A minimum of 5 test sections are to be used for a test surface that exceeds 2000 sf.
2. Conform to ASTM E1155 for the smallest permitted test section.
3. Test section is not to exceed 14,500 sf.
4. Test sections to be bound by construction joints, column or half-column lines.
TEST SECTION BOUNDARY EXAMPLE



END OF SECTION

SECTION 01 4545

CONCRETE TESTING - GLOSS TESTING FOR SLABS SUBJECTED TO ROBOTIC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes testing and reporting requirements for random traffic floor areas.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 03 3000 - Cast-in-Place Concrete

C. Section 03 3560 - Concrete Floor Finishing

1.03 SUBMITTALS

A. Equipment:
   1. Provide gloss measurement equipment data sheets.

B. Report requirements: Two reports are required, a Preliminary and Final Report. Reports are to include as a minimum the following information:
   1. Preliminary report:
      a. Floor plan drawing showing the approximate location of each test and the measured gloss value.
      b. Identify all non-complying areas on the floor plan drawing in a contrasting color.
   2. Final report:
      a. Floor plan drawing showing the approximate location of each test and the measured gloss value.
      b. The listing of the gloss values in tabular form. Data to be reported on Tenant-provided Excel Template. The Excel file is to be named as follows: Project code City, State – Concrete Floor Testing Results date when file is submitted to Owner. Example: YXZ1 Seattle, WA - Concrete Floor Testing Results XX.XX.XX.
      c. Identify all non-complying areas on the floor plan drawing in a contrasting color.

C. Report scheduling:
   1. Submit written Preliminary Report by electronic means or hand deliver to parties concerned within 36 hours, or next regularly scheduled working day, after each concrete placement. Weekends and holidays are to be ignored when computing the testing and reporting deadlines.
   2. Submit written Final Report by electronic means no later than 3 weeks prior to Tenant's Robotics Team Turn-Over-Dates. Coordinate turn-over-dates with the Tenant's Construction Manager.

1.04 QUALITY ASSURANCE

A. Testing Requirements:
   1. Responsibilities and duties of Contractor relative to Owner's testing:
      a. Notify Owner's testing agency in advance of slab's pre-construction meeting to allow sufficient time to attend meeting.
      b. Notify Owner's testing agency in advance of each concrete placement to allow sufficient time to prepare for required testing.
      c. Notify Owner's testing agency in advance of Tenant's Robotic Team Turn-Over-Dates to allow sufficient time to prepare for required testing.

B. Slab Pre-Construction Meetings:
   1. Personnel who are to perform the actual testing and those who have authority to control Work are required to attend the slab's pre-construction meetings.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Gloss Measurements
   1. Taken independent of ambient lighting and to be taken within a sealed measurement window located beneath the test unit.
   2. Approved Equipment:
      a. Elcometer 480 Triple-Angle Glossmeter
      b. MIZA Trigloss 20°/60°/85°
      c. Rhopoint IQ 20/60/85
      d. Novo-Gloss Trigloss 20/60/85
      e. Novo-Gloss Trio 20/60/85

PART 3 - EXECUTION

3.01 GENERAL

A. Follow equipment manufacturer's recommendation including device cleaning and calibration.

B. For Preliminary Report, measure, record and report gloss prior to the application of the densifier and curing compound. Testing is not to impede the application of the densifier.

C. Prior to the Tenant’s Robotics Team Turn-Over-Dates, the General Contractor shall clean the floor slab 24-HRS prior to additional testing. Cleaning shall be sufficient to remove dirt, curing compound, or any other surface contaminant that may affect gloss testing.

D. Use a dust mop or tack cloth to remove any dust or laitance from concrete surface test area prior to each test.

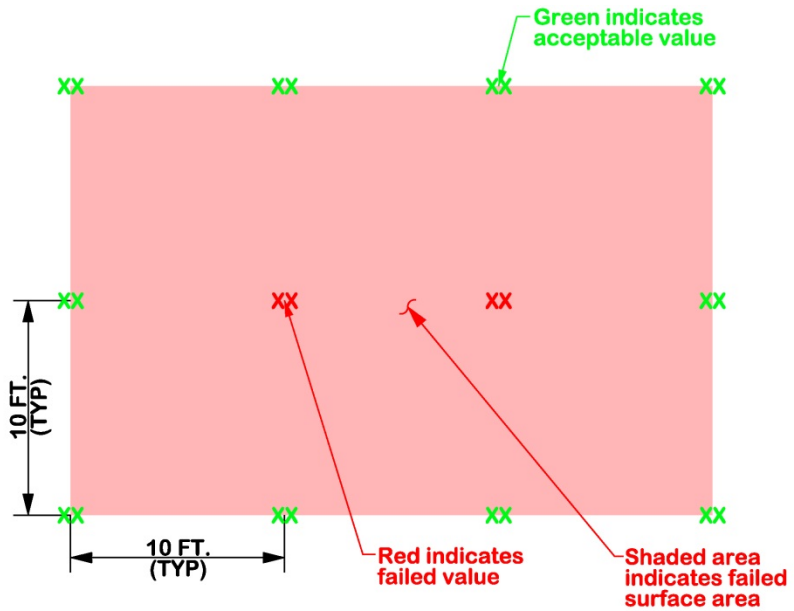
E. For Final Report, measure, record and report gloss no later than 3 weeks prior to Tenant’s Robotics Team Turn-Over-Dates.

F. Record measurement locations on the floor plan drawing. Identify all non-complying areas on the floor plan drawing in a contrasting color.

G. For Final Report, transpose gloss measurements in tabular form and report on Tenant's provided Excel Template.

H. Sample areas to be a minimum of 1 per 2000 sf.

I. If a gloss measurement fails, mark the failed location and value on the slab surface with a permanent marker in addition to recording the value on the drawing for both the Preliminary and Final Reports and in the spreadsheet for the Final Report. Complete the following procedure to identify the bounds of the failed areas.
   1. Collect four supplementary measurements 10-FT in each direction (N, S, E, W) of the failed value.
   2. If all four supplementary measurements pass, the failed area is defined as 100 square feet. Record the failed area in the correct location on the spreadsheet.
   3. If any of the four supplementary measurements fail, collect four supplementary measurements 10-FT in each direction (N, S, E, W) of the failed value(s). Repeat this procedure for all failed measurements. Below is an example.



TESTING EXAMPLE FIGURE

Notes to specifier: There are different gloss values that are to be used depending on the robotic equipment that will be used for the project. Select the appropriate gloss value, and delete the equipment type in the brackets [xxx]

J. *[H and P Systems]* Gloss values are to be a maximum of 60 at 85-degrees. Identify all non-complying areas on the floor plan drawing in a contrasting color.

K. *[G and S Systems]* Gloss values are to be a maximum of 20 at 85-degrees. Identify all non-complying areas on the floor plan drawing in a contrasting color.

END OF SECTION

SECTION 01 4555

CONCRETE TESTING - ROUGHNESS (RA) TESTING FOR SLABS SUBJECTED TO ROBOTIC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes testing and reporting requirements for random traffic floor areas.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 03 3000 - Cast-in-Place Concrete

C. Section 03 3560 - Concrete Floor Finishing

1.03 SUBMITTALS

A. Equipment:
   1. Provide roughness testing equipment data sheets.

B. Report requirements: The reports are to include as a minimum the following information:
   1. Floor plan drawing showing the approximate location of each test and the measured roughness (Ra) value.
   2. The listing of the roughness values in tabular form. Data to be reported on Tenant-provided Excel Template. The Excel file is to be named as follows: Project code City, State - Concrete Floor Testing Results date when file is submitted to Owner.
      Example: YXZ1 Seattle, WA - Concrete Floor Testing Results XX.XX.XX.
   3. Identify all non-complying areas on the floor plan drawing in a contrasting color.

C. Report scheduling:
   1. Submit final written report by electronic means no later than 3 weeks prior to Tenant's Robotics Team Turn-Over-Dates. Coordinate turn-over-dates with the Tenant's Construction Manager.

1.04 QUALITY ASSURANCE

A. Testing Requirements:
   1. Responsibilities and duties of Contractor relative to Owner's testing:
      a. Notify Owner's testing agency in advance of slab's pre-construction meeting to allow sufficient time to attend meeting.
      b. Notify Owner's testing agency in advance of Tenant's Robotics Team Turn-Over-Dates to allow sufficient time to prepare for required testing.

B. Slab Pre-Construction Meetings:
   1. Personnel who are to perform the actual testing and those who have authority to control Work are required to attend the slab's pre-construction meetings.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Surface Roughness Apparatus
   1. Approved Equipment:
      a. Starrett SR160
      b. MarSurf PS 10
      c. Taylor Hobson Ametek T-Meter II
      d. Imbotec CTM

PART 3 - EXECUTION

3.01 GENERAL

A. Follow equipment manufacturer's recommendation including device cleaning and calibration.

B. Prior to the Tenant's Robotics Team Turn-Over-Dates, the General Contractor shall clean the floor slab 24-HRS prior to testing. Cleaning shall be sufficient to remove dirt, curing compound, or any other surface contaminant that may affect roughness testing.

C. Use a dust mop or tack cloth to remove any dust or laitance from concrete surface test area prior to each test

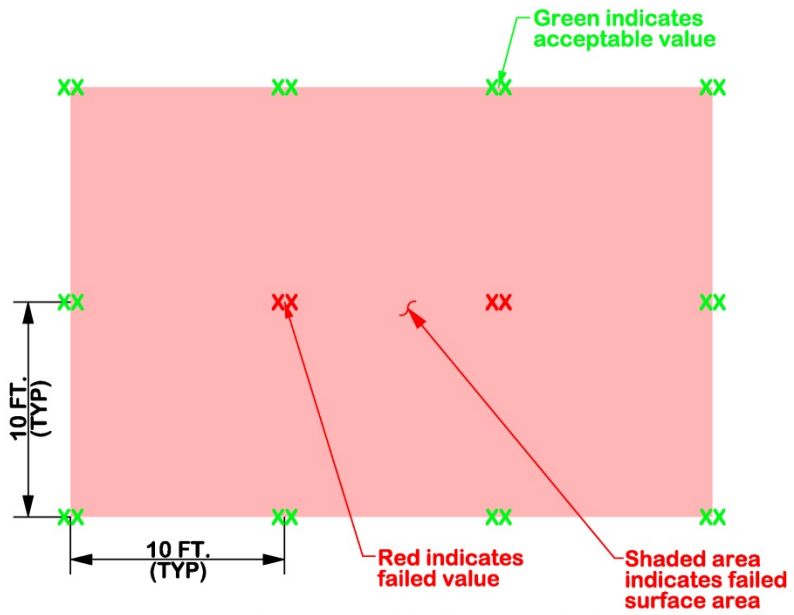
D. Measure, record and report roughness (Ra) no later than 3 weeks prior to Tenant's Robotics Team Turn-Over-Dates.

E. Record measurement locations on the floor plan drawing. Identify all non-complying areas on the floor plan drawing in a contrasting color.

F. Transpose roughness (Ra) measurements in tabular form and report on Tenant's provided Excel Template.

G. Sample areas to be a minimum of 1 per 2000 sf.

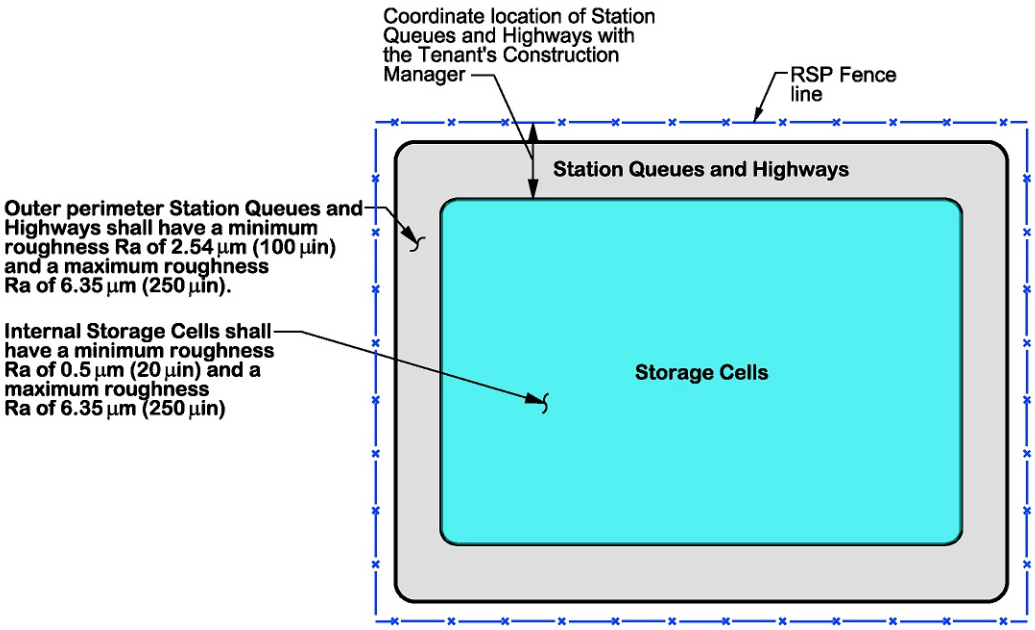
H. If a roughness (Ra) measurement fails, mark the failed location and value on the slab surface with a permanent marker in addition to recording the value on the drawings and in the spreadsheet. Complete the following procedure to identify the bounds of the failed areas.
   1. Collect four supplementary measurements 10-FT in each direction (N, S, E, W) of the failed value.
   2. If all four supplementary measurements pass, the failed area is defined as 100 square feet. Record the failed area in the correct location on the spreadsheet.
   3. If any of the four supplementary measurements fail, collect four supplementary measurements 10-FT in each direction (N, S, E, W) of the failed value(s). Repeat this procedure for all failed measurements. Below is an example.



TESTING EXAMPLE FIGURE

Notes to specifier: There are different roughness values that are to be used depending on the robotic equipment that will be used for the project. Select the appropriate Ra value, and delete the equipment type in the brackets [xxx]

I. *[G, S, and H Systems]* Roughness (Ra) requirements are to be as follows and shown in figure below:
   1. Outer perimeter Station Queues and Highways shall have a minimum roughness Ra of 2.54 µm (100 µin) and a maximum roughness Ra of 6.35 µm (250 µin). Identify all non-complying areas on the floor plan drawing in a contrasting color.
   2. Internal Storage Cells shall have a minimum roughness Ra of 0.5 µm (20 uin) and a maximum roughness Ra of 6.35 µm (250 µin). Identify all non-complying areas on the floor plan drawing in a contrasting color.



SURFACE ROUGHNESS LOCATION FIGURE

J. *[P System]* Roughness (Ra) requirements are to be a minimum 2.54 µm (100 µin) and a maximum 6.35 µm (250 µin). Identify all non-complying areas on the floor plan drawing in a contrasting color.

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Security requirements.

E. Vehicular access and parking.

F. Waste removal facilities and services.

G. Project identification sign.

H. Field offices.

1.02 TEMPORARY UTILITIES

A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

B. Provide temporary electrical service, including extensions and connections necessary for construction work. Pay costs of installing and maintaining service for duration of project. Pay costs associated with use of permanent electrical system until Date of Substantial Completion.

C. Temporary Heat and Ventilation:
   1. Provide adequate heat and ventilation required to properly complete and install all work.
   2. Provide humidity control in work and finished areas to permit proper installation and maintenance of finished work.
   3. Provide ventilation to prevent accumulation of dust, fumes or gases; to properly cure materials and disperse humidity.

D. Provide temporary water for construction purposes, including extensions and connections necessary for work. Pay costs of installing and maintaining service for duration of project. Pay costs associated with use of permanent water system until Date of Substantial Completion.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Mobile Phone Connections: Project management team.
   2. Internet Connection: Cellular hotspot connections.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. New permanent facilities may not be used during construction operations.

C. Maintain daily in clean and sanitary condition.

1.05 SAFEGUARDS DURING CONSTRUCTION:

A. Construct and maintain in accord with local building codes and OSHA regulations.

B. Temporary Controls: determine methods and procedures to be used and assume responsibility for proper protection and safety of all personnel, site, adjoining areas and structures, and public during all phases of the work. Provide all necessary boarding and fencing around all open excavation as required by applicable codes, by-laws, or governing authorities.

C. Barriers: Contractor shall be responsible for complete and proper protection from damage of existing buildings, improvements and existing parts of work to remain. Provide and maintain at all times suitable temporary barriers, partitions, and signs as necessary.

1.06 VEHICULAR ACCESS AND PARKING

A. Coordinate access and haul routes with governing authorities and Owner.

B. Provide and maintain access to fire hydrants, free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Provide and maintain temporary roadways as required to construct the Work.

1.07 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

1.08 PROJECT IDENTIFICATION

A. Construct a project sign of 3/4" thick AC plywood, approximately 4'-0" x 8'-0" painted in not more than four (4) colors, supported by 4" x 4" wood posts buried in ground 3'-0" minimum. Coordinate sign design with Architect.

B. Erect on site at location established by Architect.

C. No other signs are allowed without Owner permission except those required by law.

1.09 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture . Provide meeting space with table for at least 10 occupants.

B. Provide space for Project meetings, with table and chairs to accommodate attendees.

1.10 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Relocate temporary facilities during construction as required by progress of the Work at no additional cost to the Owner.

B. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations and procedures.

E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Product quality monitoring.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

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

2.02 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.

1. The burden of proving equality of a proposed substitute to an item designated by trade name or by manufacturer's name in the contract documents rests on the party submitting the request for approval.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver and place in location as directed; obtain receipt prior to final payment.

C. Furnish 2% extra finish materials, spare parts, and tools of types and quantities required for on-going maintenance of the Facility including expansion joint materials. Exterior and interior face of perimeter wall paint can be reduced to 1%.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Substitutions will be considered when a product, through no fault of the Contractor, becomes unavailable or unsuitable due to regulatory change.

B. A request for substitution 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.
2. Agrees to provide the same warranty for the substitution as for the specified product.
3. 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.
4. Waives claims for additional costs or time extension that may subsequently become apparent.

C. Requests for substitutions shall include the following data:

1. Date of request.
2. Project name.

3. Specification reference.
4. Specified item.
5. Proposed substitution.
6. Manufacturer.
7. Deviations from the specified item.
8. Manufacturer's recommendations for use and installation. Submit drawings if required for clarity.
9. A complete schedule of changes in the drawings and specifications, if any, which must be made in other work in order to permit the use and installation of the proposed substitute in accordance with the recommendations of the manufacturer of the product.
10. Technical data to support request for approval. List reference standards met, submit testing laboratory reports and experience records.
11. Other supporting data such as brochures, samples and drawings.
12. Samples or product literature of specified product for comparison, if requested by Architect.

D. Determination as to acceptability of proposed substitution shall be made based only on data submitted.

3.02 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.

3.03 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.

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

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

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

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

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

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

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

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

K. 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 01 6116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sustainable Intent.

B. Requirements for Indoor-Emissions-Restricted products.

C. Requirements for VOC-Content-Restricted products.

D. Requirement for installer certification that they did not use any non-compliant products.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

1.03 SUSTAINABLE INTENT

A. No LEED certification is required. Intent is to provide a "LEED like" project which is defined as a smart sustainable project. All paints, coatings, sealers, sealants, adhesives, and finishes should be low VOC and non-toxic.

1.04 DEFINITIONS

A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings.
   2. Interior adhesives and sealants, including flooring adhesives.
   3. Flooring.
   4. Composite wood.
   5. Products making up wall and ceiling assemblies.

B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Exterior and interior paints and coatings.
   2. Exterior and interior adhesives and sealants, including flooring adhesives.

C. Interior of Building: Anywhere inside the exterior weather barrier.

D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
   1. Concrete.
   2. Clay brick.
   3. Metals that are plated, anodized, or powder-coated.
   4. Glass.
   5. Ceramics.
   6. Solid wood flooring that is unfinished and untreated.

1.05 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers.

D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board.

E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board.

F. CHPS (HPPD) - High Performance Products Database.

G. CRI (GLP) - Green Label Plus Testing Program - Certified Products.

H. GreenSeal GS-36 - Adhesives for Commercial Use.

I. SCAQMD 1113 - Architectural Coatings.

J. SCAQMD 1168 - Adhesive and Sealant Applications.

K. SCS (CPD) - SCS Certified Products.

L. UL (GGG) - GREENGUARD Gold Certified Products.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of these products, or 2) that such products used comply with these requirements.

1.07 QUALITY ASSURANCE

A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
   1. Wet-Applied Products: State amount applied in mass per surface area.
   2. Paints and Coatings: Test tinted products, not just tinting bases.
   3. Evidence of Compliance: Acceptable types of evidence are the following;
      a. Current UL (GGG) certification.
      b. Current SCS (CPD) Floorscore certification.
      c. Current SCS (CPD) Indoor Advantage Gold certification.
      d. Current listing in CHPS (HPPD) as a low-emitting product.
      e. Current CRI (GLP) certification.
      f. Test report showing compliance and stating exposure scenario used.
   4. Product data submittal showing VOC content is NOT acceptable evidence.
   5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.

B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that product complies with requirements.

C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scscertified.com.
      b. Report of laboratory testing performed in accordance with requirements.
      c. Published product data showing compliance with requirements.

D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
   1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
   2. Inherently Non-Emitting Materials.

C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
   2. Aerosol Adhesives: GreenSeal GS-36.
   3. Joint Sealants: SCAQMD 1168 Rule.
   4. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

3.02 SCHEDULE

A. Listing of materials and maximum allowable VOC limits based on USGBC and CARB. All are listed as grams/liter (g/L).

B. Coatings, Paints and Sealers
   1. Concrete/Masonry Sealers - 100
   2. Dry Fog / Dryfall - 150
   3. Fire Resistive - 350
   4. Flat - 50
   5. Floor - 100
   6. Form Release Compounds - 250
   7. Nonflat Coatings - 100
   8. Primers, sealers, undercoatings - 100
   9. Reactive Penetrating Sealers / Sanding Sealer - 350
   10. Rust Preventative - 250
   11. Stains - 250
   12. Traffic Marking - 100
   13. Wood Coatings - 275
   14. Zinc Rich Primers - 340
   15. Unidentified Other Coatings - Flat - 100
   16. Unidentified Other Coatings - Nonflat - 150

C. Adhesives and Sealants
   1. Indoor Carpet Adhesives - 50
   2. Rubber Floor Adhesives - 60
   3. Ceramic Tile Adhesive - 65

4. VCGT and Asphalt Adhesive - 50
5. Drywall and Panel Adhesive - 50
6. Cove Base Adhesive - 50
7. Multipurpose Construction Adhesive - 70
8. Sealants - 250

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surveying for laying out the work.

B. Cleaning and protection.

C. Starting of systems and equipment.

D. Demonstration and instruction of Owner personnel.

E. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures.

B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

D. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

E. Section 01 9113 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.

1.03 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water.

B. Contractor shall endeavor to keep the site free from unnecessary damage from rain, surface or subsurface water. Water shall not be allowed to accumulate in excavations or under or about the structures. The Contractor at the end of each day should seal the site so that it drains and ensure that areas do not exist which would hold water. Should such conditions develop or be encountered, the water shall be kept constantly controlled and legally disposed of by temporary pumps, piping, ditches, dams or other methods.

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

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

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.

1.04 COORDINATION

A. 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.

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

C. 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.

D. 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.

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

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

G. 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 - NOT USED

PART 3 EXECUTION

3.01 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. Utilize recognized engineering survey practices.

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

F. Periodically verify layouts by same means.

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

3.02 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.

3.03 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.

3.04 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. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

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

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.

3.05 SYSTEM STARTUP

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

B. 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.

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

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

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

F. 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.

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

3.06 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.07 ADJUSTING

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

3.08 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion. Clean-up all interior and exterior areas of the Building and Site.

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. Clean 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. All concrete curb and gutter and concrete pavement and walks shall be pressure cleaned during final clean-up.

J. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

K. Building interior space, including roof structure, columns, joists, girders, walls, windows, floor slabs, fixtures, and equipment must be left clean of dirt and debris as a result of construction

activities or residue from site storage (i.e. tire marks, oil/grease, layout scribe lines, etc.). Vacuum carpeted and soft surfaces.

L. Warehouse slab shall be cleaned utilizing floor scrubbers at the following milestones:
   1. Prior to Early Occupancy
   2. Prior to or as directed in advance of floor taping.
   3. Prior to First Received turnover of building.

3.09 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. 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.

D. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

E. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

F. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 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. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

E. 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.

F. 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.

1.02 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, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, 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.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Recycled and Salvaged Materials: Include the following information for each:
      a. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
      b. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      c. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      d. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
   5. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Pre-bid meeting.
   2. Pre-construction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

END OF SECTION

SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Upon receiving the Certificate of Substantial Completion, Contractor shall prepare, assemble and transmit the items listed herein within ten days.
   1. Project Record Documents:
      a. Submit complete set of reviewed shop drawings to Owner in electronic PDF format.
      b. Submit PDF of As-Built drawings scanned at original scale to Architect.
   2. Warranties, Bonds, and Operation and Maintenance Data: Submit one hard copy of the items listed to Owner and Architect for review. Make any requested revisions to the submittal, and upon satisfactory completion, submit in electronic PDF format.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

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. As-Built Drawings and Shop Drawings: On a complete set of prints, legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 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. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

D. Prepare data in the form of an instructional manual.

E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

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

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

H. 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.

I. 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.

J. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

K. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. List of equipment.
      b. Parts list for each component.
      c. Operating instructions.
      d. Maintenance instructions for equipment and systems.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Photocopies of warranties and bonds.

3.03 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. Include photocopies of each in operation and maintenance manuals, indexed separately on Table of Contents.

D. Manual: Bind in commercial quality 8-1/2 by 11 inch binders with durable plastic covers.

END OF SECTION

SECTION 01 7900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 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. Landscape irrigation system.
   3. Loading dock equipment.
   4. HVAC systems and controls.
   5. Plumbing equipment.
   6. Electrical power distribution and equipment.
   7. Electrical lighting controls.
   8. Fire protection system and fire pump.
   9. Emergency generator.
   10. Fire alarm system.
   11. Motorized gates and traffic arms.

1.02 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

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

1.03 SUBMITTALS

A. 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.

1.04 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

3.01 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 within two weeks after Substantial Completion.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations within two weeks after Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.

B. Provide training in minimum two hour segments.

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 01 9113
GENERAL COMMISSIONING REQUIREMENTS

PART1 GENERAL

1.01 RELATED DOCUMENTS

A. Design Criteria, Drawings, Owner's Commissioning Plan and Scope, Special Conditions and Forms, and Division 01 Specifications Sections apply to this section.

B. Owner's Project Requirements and Basis of Design (BOD) documents - for information only.

1.02 SUMMARY

A. An independent commissioning provider (CxP) has been retained to implement and coordinate the commissioning process for this project. The objectives of the commissioning process are to:
   1. Achieve, verify and document that the performance of facilities, systems, and assemblies meet defined objectives and criteria.
   2. Verify that O&M documentation left on site is complete.
   3. Verify that the Owner's operating personnel are adequately trained.

B. The commissioning process includes specific tasks to be conducted during each phase in order to verify that design, construction, operation and occupancy meet the Owner's Project Requirements.

C. This section defines the members of the Commissioning Team (CxT) and outlines the responsibilities of each member of the CxT. All CxT members work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

D. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

E. Participating CxT entities shall each include the cost to complete their work of the commissioning process in their proposal.

1.03 COMMISSIONED SYSTEMS

A. Mechanical (if applicable):
   1. 100% Air Cooled Units (RTU/CRAC)
   2. Gas Detection System - including but not limited to H2, NOx, CO
   3. Humidifier/Dehumidifier
   4. 20% Electric Wall Heaters
   5. 20% Electric Ceiling Heaters
   6. 20% Circulation Fans (Permanently installed HVLS, Patterson, other)
   7. 20% Exhaust Fans
   8. 20% VAVs
   9. 20% Fire Suppression System
   10. 20% Plumbing Systems (Sewer lines & pumping station)
   11. 20% Dock Doors and Dock Locks.
   12. 20% Indoor Air Quality Devices (CO2, RH, T)
   13. BMS
   14. Guard house and all applicable systems

B. Electrical (if applicable):
   1. Power Generation
   2. UPS
   3. PDU
   4. EPO
   5. 20% Lighting and Lighting Control Systems - including daylight, occupancy and time-of-day
   6. 20% Panel boards 100 amp and larger
   7. 20% Panel boards under 100 amps
   8. 100% Switchboards

9. 20% Transformers
10. Power Monitoring - including mains and sub-panels
11. Surge Protection Devices
12. Busways
13. Transfer Switches
14. Arc Flash Coordination Studies (pre- and post-MHE installation)
15. IT Communication Strength of Wired and Wireless Network
16. Solar (if owned by Owner)
17. Security - including egress locks, turn stiles and security camera location and positions, door locks

C. General (if applicable):
1. Structural Improvements for Natural Disaster Preparedness

D. Fire Protection Systems - Review Documentation Completed by Others:
1. Fire suppression systems
2. Fire alarm systems
3. Smoke removal systems (where provided)

1.04 DEFINITIONS

A. Acceptance: A formal action taken by a person with appropriate authority (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

B. Basis of Design: A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

C. Checklists: Verification checklists that are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements are being achieved. This includes checklists for general verification plus testing, training, and other specific requirements.

D. Commissioning or Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

E. Commissioning Process Activities: Components of the commissioning process.

F. Commissioning Process Progress Report: A written document that details activities completed as part of the commissioning process and significant findings from those activities, which is continuously updated during the course of a project.

G. Commissioning Provider: The entity identified by the Owner who plans, schedules, and coordinates the commissioning team to implement the commissioning process.

H. Commissioning Request for Information (RFI): Form used by the CxP to request information from the design and construction team.

I. Commissioning Team: The individuals who through coordinated actions are responsible for implementing the commissioning process.

J. Coordination Drawings: Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.

K. Deferred Performance Tests (DPTs): Performance tests that are performed at the discretion of the CxPCxP after Substantial Completion due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that do not allow the test to be performed.

L. Deficiency: A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the contract documents.

M. Document Request Log: A log maintained by the CxP to list and track documents requested from the design and construction team.

N. Factory Testing: Testing of equipment on site or at the factory by factory personnel with or without an Owner's representative present.

O. Functional Performance Test: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment assemblies, systems, and interfaces among systems.

P. Issues Log: A formal and ongoing record of problems or concerns - and their resolution - that have been raised by members of the commissioning team during the course of the commissioning process.

Q. Non-Compliance: See Deficiency.

R. Non-Conformance: See Deficiency.

S. Owner's Project Requirements: A written protocol that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, and supporting information.

T. Phased Commissioning: Commissioning that is completed in phases as required by the phasing plan as approved for the project and other scheduling issues.

U. Pre-Functional/Startup Checklist: A form used by the Contractor to verify that appropriate components are on site, ready for installation, correctly installed, and functional.

V. Seasonal Performance Tests: Performance tests that are deferred until the system(s) will experience conditions closer to their design conditions based on weather conditions.

W. Commissioned Systems Resource Manual (CSRM): A system-focused document that refers to reference materials and their physical location and bound information within the CSRM that includes the operation manual, maintenance manual, and additional information of use to the Owner during the occupancy and operation phase.

X. Training Plan: A written document that details the expectations, schedule, budget, and deliverables of commissioning process activities related to training of project operating and maintenance personnel, users, and occupants.

Y. Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

1.05 SUBMITTALS

A. The CxP will provide the Contractor with a specific request for the type of submittal documentation the CxP requires facilitating the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction project. All documentation requested by the CxP will be included by the Contractor in the O&M Manual.

B. The CxP will review submittals related to the commissioning of equipment for conformance to the contract documents as it relates to the commissioning process, to the performance of the equipment, and adequacy for developing test procedures. This review is intended primarily to aid in the development of performance test procedures and only secondly to verify compliance with equipment specifications. The CxP will follow communications protocol to notify those required of items missing or areas that are not in conformance with contract documents and which require submission.

C. CxP shall receive submittals concurrent to Architect/Engineer. CxP will provide comments, when required, to Architect/Engineer for inclusion in their comments to contractors.

D. Shop Drawings:

1. Include a complete bill of material of equipment used indicating quantity, manufacturer and model number and other relevant technical data.
2. Include manufacturer's description and technical data, such as performance curves, performance test procedures, product specification sheets, schedules, settings and installation, operation and maintenance instructions, and detailed startup procedures.
3. Submittals shall contain outline dimensions, layout details, operating and maintenance clearances, and sufficient engineering data to indicate compliance with the specifications.
4. Scale and Measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
5. Each piece of equipment shall be identified by the number shown in the schedules and specification article number pertaining to the item. Shop drawings shall, at a minimum, be 1/4-inch equal 1'-0" scale, and shall be newly prepared by the Contractor and not reproduced from the Architect/Engineer's drawings.
6. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project will be highlighted or clearly indicated by other means. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.
7. Shop drawings to be provided to the CxP include, at minimum, all applicable systems identified within section 1.3 COMMISSIONED SYSTEMS.

E. The CxP may request additional submittals/information not listed above and design narrative from the Architect/Engineer, Contractor, and/or equipment suppliers, etc.

F. Submittals to the CxP do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, through the CxP will review and approve them.

1.06 COMMISSIONING TEAM

A. Members appointed by Contractor: Individuals, each having expertise and authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxP.
   1. Developer and Tenant to review the list of Cx providers and shortlist firms to provide proposals.
   2. The Cx provider proposals are reviewed by the Tenant and Developer, and are hired by either Tenant or the Developer.

B. Members appointed by Owner:
   1. CxP: An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner has engaged the CxP under a separate contract.
   2. Representatives of the facility user and operation and maintenance personnel.
   3. Architect and engineering design professionals (A/E).

C. Members of the Commissioning Team, at minimum, to include:
   1. Construction Manager
   2. Reliability and Maintenance
   3. Architect/Engineer (A/E)
   4. General Contractor
   5. Mechanical Subcontractor
   6. Major HVAC Equipment Suppliers
   7. Instrumentation and Controls Subcontractor
   8. Instrumentation and Controls Supplier
   9. Test and Balance Subcontractor
   10. Commissioning Provider

D. Preferred Commissioning Vendors with negotiated pricing:
   1. Jacobs Engineering Group, Inc.
      Laura Rolf

Laura.Rolf2@jacobs.com
Main: 281.721.8587
Locations: US, Australia, Singapore, Canada, France, Germany, Italy, Romania and UK

2. Jaros, Baum & Bolles
   Ryan S. Lean
   leanr@jbb.com
   Main: 212.530.9300, Direct: 212.530.9447
   Locations: US, Mexico and Canada
3. Bureau Veritas Primary Integration
   Todd Stafford
   todd.stafford@bureauveritas.com
   Cell: 703.928.2610
   Locations: US, Canada, Brazil, Singapore and Australia
4. McDonough Bolyard Peck, Inc. (MBP)
   Scott Higgins
   shiggins@mbpce.com
   Office: 800.898.9088, Cell: 571.733.0927
   Locations: US, Canada and Mexico
5. Morrison Hershfield
   Sean Smith
   SSmith@morrisonhershfield.com
   Cell: 905.630.8265, Office: 289.266.1908
   Locations: US and Canada
6. Baumann Consulting
   Oliver Baumann
   O.Baumann@baumann-us.com
   Office: 312.386.7710, Cell: 202.446.6659
   Locations: US, Canada, Mexico and Germany
7. Hargis Engineers inc
   Brian Haugk
   Brian.Haugk@hargis.biz
   Office: 206.436.0405, Cell: 206.355.4236
   Locations: US
8. National Facility Solutions
   Scott Wolf
   swolf@natfas.com
   Cell: 612.720.3465, Office: 651.319.0170
   Locations: US

1.07 RESPONSIBILITIES

A. All CxT Members:
   1. Attend preconstruction commissioning meeting and regularly scheduled construction meetings by phone, or in person, as necessary.
   2. Cooperate with all CxT members to carry out commissioning process.
   3. Include the price of commissioning responsibilities/tasks in each CxT member's proposal.

B. Commissioning Provider (CxP):
   1. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, updated timelines, schedules, and technical expertise.
   2. The CxP shall develop specific commissioning documentation. This commissioning documentation shall be kept in three-ring binders. All pages shall be numbered, and a

table of contents page(s) shall be provided. The CxP developed commissioning documentation shall include, but not be limited to, the following:
   a. Commissioning schedule
   b. Commissioning RFIs
   c. Issues log
   d. Pre-functional/startup checklists
   e. Functional performance test procedures
   f. Commissioning team meeting minutes
   g. Final commissioning report
3. Additional documentation required of the commissioning process that the CxP shall verify is in place and review (when contracted to do so) includes the following:
   a. Owner's Project Requirements document
   b. Basis of Design document
   c. Shop drawing submittals
   d. Installation, operation and maintenance (O&M) manuals
   e. Training materials, agenda and training schedules for Owner's operating personnel
   f. As-built documentation
   g. Warranties for equipment, systems and project
   h. Test and balance reports
   i. Results of factory tests specified in Divisions 23 and 26 Sections of this specification for construction
   j. Results of tests specified in Divisions 23 and 26 Sections of this specification for construction
   k. Commissioned systems resource manual
4. Provides oversight of Contractor training with regards to testing process, forms used, and approval process.
5. The CxP may assist with problem solving, non-conformance or deficiencies, but ultimately that responsibility resides with the Contractor and the Architect/Engineer.
6. The CxP is not responsible for the design concept, design criteria, compliance with codes, review or approval of change orders, design or construction scheduling or cost estimating.
7. The CxP coordinates the commissioning work and, with the Contractor, ensures that commissioning activities are being incorporated into the construction schedule maintained by the Contractor.
8. Plans and conducts a pre-construction commissioning meeting and other commissioning meetings.
9. Prepares meeting agendas, meeting minutes and distributes to the commissioning team.
10. Requests and reviews additional information required to perform commissioning tasks, including O&M materials and Contractor pre-functional/startup checkout procedures.
11. Reviews normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the Architect/Engineer's reviews.
12. Develops a startup, checkout, Contractor-directed test, CxP-witnessed test and integrated system test plan with Contractor.
13. Attends selected planning and job-site meetings to obtain information on construction progress. Reviews construction meeting minutes for revisions/substitutions relating to the commissioning process. Assists in resolving any discrepancies.
14. Conducts periodic construction observations, as contracted, to verify that systems and equipment are installed consistently with Owner's Project Requirements, Basis of Design and contract documents. Documents deficiencies in the issues log and distributes to the CxT. (Note: The CxP is responsible for identifying deficiencies but is not responsible for ensuring that deficiencies are corrected. Also note that CxP observations are not intended to take the place of design team observations.)
15. Approves pre-functional checklist/startup completion by reviewing checklist reports and by selected site observation.

16. With necessary assistance and review from the Architect/Engineer and Contractor, writes the functional test procedures and integrated systems test procedures for equipment and systems.
17. Reviews the control sequences and interlocks and works with Contractor and Architect/Engineer until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
18. Reviews and approves completed Contractor-directed functional performance test forms.
19. Directs and witnesses functional performance.
20. Coordinates retesting as necessary until satisfactory performance is achieved.
21. Analyzes any performance trend logs and monitoring data to verify performance.
22. Reviews test and balance execution plan.
23. Reviews test and balance reports along with Architect/Engineer.
24. Directs and witnesses integrated systems testing conducted by Contractor.
25. Recommends acceptance of the individual systems and assemblies to the Owner.
26. Maintains a master issues log and a separate testing record. Provides the Owner, Architect/Engineer, and Contractor with written progress reports and test results with recommended actions.
27. Verifies the training of the Owner's operating personnel has been completed.
28. Reviews equipment warranties to ensure that the Owner's responsibilities are clearly defined.
29. Compiles and maintains commissioning documents.
30. Coordinates and supervises required seasonal or deferred testing and deficiency corrections.

C. Owner:
1. Defines the Owner's Project Requirements (OPR), provides interpretations and clarifications to the OPR, and provides OPR document to CxP and Contractor for information and use.
2. Manages the contract of the Architect/Engineer and Contractor.
3. Facilitates the coordination of the commissioning work by the CxP, and, with the Contractor and CxP, ensures that commissioning activities are being scheduled into the construction schedule.
4. Assigns operations and maintenance personnel and arranges for them to participate in the various meetings and observations/inspections as follows:
   a. Design/construction phase coordination meetings
   b. Procedure meetings for testing systems
   c. Pre-functional/startup checkouts
   d. Functional testing
   e. Integrated systems testing
   f. Systems testing
5. Assists with gathering of documents requested of CxT members.
6. Provides the Basis of Design documents, approved by Owner, to the CxP and Contractor.
7. Reviews, comments and approves the commissioning plan.
8. Reviews, comments and approves the construction documents.
9. Performs review of Contractor submittals.
10. Coordinates site visits and meetings with the CxP.
11. Attends commissioning meetings, pre-functional/startup procedures, and functional testing.
12. Reviews, comments and approves the CxP's functional test reports.
13. Provides access to areas of the facility in a timely manner for commissioning team to perform its work.
14. Reviews commissioning progress reports and issues log.
15. Coordinates the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
16. Develops final punchlist for the construction project.

17. Reviews and accepts the CxP's final commissioning report and provides final approval for the completion of the commissioning work.
18. Ensures that any seasonal or deferred testing and any deficiency issues are addressed.
19. Participates in warranty review activities ten months into 12-month warranty period with other members of the CxT.

D. Architect/Engineer (A/E):
1. Provides documentation of design intent/basis of design based on Owner's Project Requirements.
2. Prepares construction contract documents.
3. Specifies and verifies adequate maintenance access for each piece of equipment in design, shop drawings, and actual installation.
4. Provides system design parameters to Owner and obtains approval.
5. Provides any design narrative documentation requested by the CxP. This includes clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Notifies the CxP of substantive changes to the contract documents.
7. Reviews and comments on pre-functional/startup checklists, functional performance test procedures, and integrated systems test procedures submitted by the CxP.
8. Reviews and approves submittals.
9. Provides periodic site observations as contracted.
10. Witnesses testing of selected equipment and systems.
11. Reviews and comments on CxP's commissioning progress reports and issues logs.
12. Reviews and approves O&M data and training plan.
13. Reviews and/or prepares as-built documents from Contractor record documents as contracted.
14. Prepares punchlists.
15. Prepares final Basis of Design document.
16. Reviews and approves test and balance plan and reports.
17. Provides designer's intent training for Owner's operating personnel, if included in Architect/Engineer contract.
18. Coordinates the resolution of system deficiencies identified during commissioning.
19. Coordinates resolution of design non-conformance and deficiencies identified during warranty period commissioning.
20. Recommends final acceptance of the systems to the Owner.
21. Reviews and comments on the final commissioning report.

E. Contractor:
1. The Contractor is responsible for his commissioning activities and coordinating all commissioning activities of his subcontractors and equipment suppliers.
2. Facilitates the coordination of commissioning work by the CxP and ensures that the Contractor, his subcontractors, and all other CxT member commissioning tasks/activities are incorporated into the construction schedule.
3. Furnishes a copy of all construction documents, addenda, change orders, requests for information, and approved submittals and shop drawings related to commissioned equipment/systems to CxP.
4. Includes requirements for submittal data, O&M data, commissioning tasks and training in each purchase order or subcontract written.
5. Performs review of submittals.
6. Ensures that all subcontractors execute their commissioning responsibilities according to the contract documents and schedule.
7. Attends Contractor training conducted by CxP concerning commissioning process, forms to be used, testing requirements, commissioning process deliverables and scheduling.
8. Attends CxT meetings.
9. Provides functional testing plan in accordance with procedures supplied in this section.

10. Responds to (in writing) and addresses items documented in the issues log.
11. Notifies the CxP six weeks in advance of all equipment startup, Contractor-directed testing, and tests required by contract documents.
12. Contractor to certify that equipment/systems have been installed per manufacturer's instructions.
13. Reviews and makes comment on the pre-functional/startup checklists and functional performance test procedures developed by CxP.
14. Submits test results for tests required by the contract documents, if applicable, including (but not limited to) test and balance, duct leakage tests, plumbing system disinfection certification, fire alarm tests, etc. as performed.
15. Completes pre-functional/startup checkout forms to CxP for review and approval.
16. Completes Contractor-directed functional performance testing. This testing mandates the participation of Contractor and all subcontractors involved with systems integration, such as mechanical, electrical, and controls subcontractors. Submits completed Contractor directed functional test forms to CxP for review and approval.
17. Notifies the CxP when systems and assemblies are ready for CxP-witnessed testing.
18. Remedies any deficiencies identified in the pre-functional/startup checklists and Contractor-directed functional performance testing and notifies CxP (in writing) that deficiencies have been addressed.
19. Coordinates and facilitates the resolution of non-compliance, deficiencies and discrepancies identified in all phases of commissioning.
20. Notifies the CxP four weeks in advance when test and balancing activities are to start and when their activities have been completed.
21. Provides qualified personnel for performing all test procedures, including functional performance testing witnessed by CxP.
22. Performs functional performance testing of assemblies and systems witnessed by the CxP.
23. Coordinates training of Owner personnel. Develops training agenda, training materials, conducts training sessions. Schedules subcontractors, equipment suppliers, etc. to participate in training the Owner's personnel. Coordinates with Owner schedule for training Owner operating personnel.
24. Provides training agenda, materials and schedules to CxP for review and comment.
25. Prepares O&M manuals according to the contract documents, including clarifying and updating the original sequences of operation to as-built conditions. Submits O&M manuals to CxP for review prior to Owner operating personnel training. O&M manuals are to be used in training sessions.
26. Submits complete set of as-built records to CxP for review.
27. Ensures that Contractor and subcontractors execute seasonal and deferred functional performance testing, witnessed by the CxP, according to the specifications.
28. Ensures that Contractor and subcontractors correct deficiencies and make necessary adjustments to O&M manuals and as-built records for applicable issues identified in any seasonal or deferred testing.
29. Participates in warranty review activities coordinated by CxP prior to termination of warranty period.

F. Equipment Suppliers:
1. Provides all requested submittal data, including detailed startup procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assists in equipment testing per agreements with Contractor.
3. Includes all special tools and instruments (only available from equipment supplier, specific to a piece of equipment) required for testing equipment according to these contract documents.
4. Analyzes specified products and verifies that the Architect/Engineer has specified the newest, most updated equipment reasonable for this project's scope.
5. Provides information requested by CxP regarding equipment sequence of operation and testing procedures.

6. Reviews and approves test procedures for equipment installed by factory representatives.
7. Provides personnel, services, documents, tools, etc. for those responsibilities listed under Contractor that are applicable to equipment suppliers.

1.08 COORDINATION

A. The CxP shall receive a copy of all construction documents, addenda, change orders, and appropriate approved submittals and shop drawings related to commissioned system/equipment directly from the Contractor.

B. The CxP shall disseminate written information and documents to all responsible parties relative to the nature and extent of the communication.

C. The CxP is primarily responsible to the Owner and, as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status reports on progress with each system. Any potential change in the contractual and/or financial obligations of the Owner (credits, change orders, schedule changes, etc.) shall be identified and quantified as soon as possible.

D. The CxP shall coordinate the schedule of commissioning activities with the construction schedule. It is possible that some procedures will be completed before the entire system is completed.

1.09 SCHEDULE

A. Contractor schedules and scheduling is the responsibility of the Contractor. The CxP shall provide commissioning scheduling information to the Contractor for review and planning activities. CxP-developed commissioning activities to be integrated into the construction schedule by the Contractor.

B. The schedule shall incorporate sufficient time for the following commissioning process steps:
   1. Equipment/systems shall be installed per manufacturer's instructions.
   2. Pre-functional/startup checklists will be completed by the field personnel implementing the startup procedure, field personnel to sign the completed form, and submit signed checklist to CxP for review and approval.
   3. Contractor Directed Functional Testing: The Contractor shall perform functional performance testing of systems/equipment once pre-functional/startup checklists have been approved by CxP. Personnel actually carrying out Contractor-directed functional performance testing are to fill out test forms during the "Contractor-Directed" testing and the appropriate contracting team personnel shall sign the completed forms. Submit signed, completed forms to CxP for review and approval.
   4. CxP Witnessed Functional Testing: The Contractor shall perform functional performance testing to be witnessed by the CxP after step 3 above has been completed. The CxP shall complete and sign functional performance test forms for those tests completed in this step 4.

C. The Contractor will integrate all commissioning activities into the overall construction schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. Problems observed shall be addressed immediately, responsible parties notified, and actions taken to correct deficiencies coordinated in a timely manner.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. All industry standard test equipment, special tools, ladder/lifts, two-way radios and equipment required for performing the specified tests shall be provided by the Contractor and shall be approved by the CxP. The Owner shall furnish necessary utilities for the commissioning process.

B. Any portable or hand-held setup/calibration devices required to initialize the control system shall be provided by the control system subcontractor and equipment supplier for testing.

C. The instrumentation used in the commissioning process shall meet the following standards:
   1. Be sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
   2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument.
   3. Be maintained in good repair and operating condition throughout the duration of use on this project.
   4. Be immediately recalibrated or repaired if dropped and/or damaged in any way during use on this project.

2.02 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or startup, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 EXECUTION

3.01 MEETINGS

A. The CxP will schedule, plan and conduct an initial commissioning meeting with the Contractor. The Contractor and its responsible parties are required to attend.

B. Other meetings will be planned and conducted by the CxP as construction progresses. The meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held at least monthly until the final three months of construction, when they may be held as frequently as one per week.

3.02 CONSTRUCTION OBSERVATION

A. CxP construction observation is an additional and separate activity from that provided by the design team. Construction observation is required as part of the commissioning and coordination process to be provided by them.

3.03 TEST AND BALANCE (TAB)

A. Air and water test and balance shall be accomplished by a test and balance firm as specified by the Architect/Engineer.

3.04 PRE-FUNCTIONAL/STARTUP CHECKLIST

A. The following procedures apply to all equipment/systems to be commissioned.

B. Pre-functional/startup checklists are important to verify that the equipment and systems are installed, fully connected and ready to operate in accordance with contract documents. It insures that performance testing (in-depth system checkout) may proceed without unnecessary delays. The pre-functional/startup checklist for a given system must be successfully completed and approved prior to formal performance testing of equipment or subsystems of the given system.

C. The CxP will coordinate with Contractor and his subcontractors for the commissioned equipment/system to create a pre-functional/startup checklist that is specific to the particular equipment/system. The intent of the pre-function/startup checklist is to incorporate the manufacturer's startup routines and CxP's initial checkout and startup requirements.

D. CxP will approve the final content and documentation format for all pre-functional/startup checklists used for commissioned equipment/systems on this project.

E. The Contractor shall determine which trade is responsible for executing and documenting each of the line item tasks and transmit the checklist to the responsible subcontractors. Each form may have more than one trade responsible for its execution.

F. The Contractor and his subcontractors are to provide the services of personnel to implement the pre-functional/startup checklists.

G. The Contractor is to provide access to contract plans, shop drawings, equipment cut sheets, control system schematics, narrative description of control sequences of operation, as-built wiring schematics, sub-system interfaces and interlocks.

H. Execution of Pre-functional/Startup Checklists:
   1. Six weeks prior to the scheduled startup, the Contractor shall coordinate startup and checkout with the Owner, Architect/Engineer and CxP. The execution of the pre-functional/startup checklists, startup, and checkout shall be directed and performed on 100% of the equipment/systems by the personnel of the Contractor, subcontractors and/or equipment suppliers. Signatures are required of personnel performing pre-functional/startup checklist tasks for verification of completion of their work.
   2. The Owner and Architect/Engineer, as necessary, shall observe the execution of pre-functional/startup checklists.
   3. The CxP will observe execution of pre-functional/startup checklists based on sampling strategy identified in the commissioning plan.
   4. The personnel of the Contractor, subcontractors, and equipment suppliers shall execute startup and Contractor shall provide the CxP with a signed and dated copy of the completed pre-functional/startup checklists.
   5. Only personnel of the Contractor (technicians, engineers, tradesmen, equipment suppliers, etc.) who have direct knowledge and witnessed that a line item task on the pre-functional/startup checklist was actually performed shall check off that item. It is not acceptable for witnessing supervisors to fill out these forms.
   6. CxP will review and approve pre-functional/startup checklists submitted by Contractor.

I. Sample pre-functional/startup checklists are made a part of the project specifications and are found in an appendix of this specification.

J. Pre-functional/startup checklists filled out by the appropriate personnel, signed and approved by the CxP will be included in the commissioning report.

3.05 CXP WITNESSED FUNCTIONAL PERFORMANCE TESTING

A. The CxP will provide test scripts to be used for CxP-witnessed testing.

B. The CxP will be on site and execute functional performance testing to be witnessed by the CxP.

C. Execution of CxP-Witnessed Functional Performance Testing:
   1. CxP-witnessed functional performance testing will not proceed until Contractor-directed functional testing has been completed, forms have been completed and signed by the appropriate personnel, and CxP has reviewed and approved the test forms.
   2. CxP shall coordinate with Owner and Architect/Engineer that Contractor-directed testing has been approved by CxP.
   3. Contractor shall notify contracting team that the CxP witness testing can proceed and that scheduling of CxP-witnessed testing should occur.
   4. CxP-witnessed testing shall occur no sooner than 48 hours from approval of CxP approval of Contractor-directed functional performance testing.
   5. In some cases, multiple identical piece of equipment will be witness tested by CxP using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates the common identity. A small size or capacity difference alone does not constitute a difference.
   6. CxP-witnessed testing will occur when enough equipment/systems have met CxP approval of Contractor-directed functional performance testing and can be grouped together to be efficient for CxP to be on site.
   7. During CxP-witnessed testing the contracting team executing/performing the mechanical/integrated automations systems test will execute the functional performance test which includes, at minimum:
      a. Set the system equipment into the operating mode to be tested (i.e. normal shut-down, normal auto position, normal manual position, unoccupied cycle, emergency power and alarm conditions etc.).
      b. Repeat test for each operating cycle that applies to the system being tested.

c. Perform operating checks of all safety cutouts, alarms, and interlocks with life safety and smoke control (if applicable) systems during all modes of operation of the mechanical/electrical systems.

8. During CxP-witnessed testing, the contractor team executing/performing the fire suppression systems test will execute the functional performance test which includes, at minimum:
   a. Set the zone into the test mode (i.e. each clean agent system is fully disarmed, pre-action sprinkler valve is closed, etc.).
   b. Perform a functional test of devices (manual release stations, abort stations, smoke detectors, keyed maintenance switch, etc.) and compare each result against the Sequence of Operations Matrix as supplied by the Architect/Engineer.
   c. Repeat test for each zone that applies.
   d. Perform operating checks of all signals sent to monitoring facilities and interlocks with smoke control and HVAC systems during all modes of operation of the fire suppression systems.
9. The CxP shall inspect and verify the position of each device and interlock identified in the test procedure. Each item shall be signed off as acceptable (yes) or failed (no).
10. During CxP-witnessed functional testing, the CxP will document results of the test on the functional performance test forms.
11. If during the test an operating deficiency is observed, appropriate comments will be added to the test procedure form and the issue log.
12. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxP. In such cases the deficiency and resolution will be documented on the procedure form or an attached sheet.

D. Non-Conformance
1. As tests progress and a deficiency is identified, the CxP shall discuss the issue with the commissioning team and the Contractor.
2. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:
   a. The CxP will document the deficiency and the Contractor's response and intentions. The CxP will submit the non-compliance reports to the Owner. The Contractor corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxP.
   b. The Contractor shall reschedule the test, and the test is repeated.
3. If there is a dispute about a deficiency, regarding whether or not it is a deficiency:
   a. The dispute shall be documented on the non-compliance form with the Contractor's response.
   b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with Architect/Engineer. Final acceptance authority is with the Owner.
   c. The CxP documents the resolution process.
   d. Once the interpretation and resolution have been decided, the Contractor corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxP. The Contractor shall reschedule the test and the test is repeated until satisfactory performance is achieved.
4. Cost of retesting a performance test shall be paid by the Contractor.
5. The Contractor shall submit in writing to the Owner and CxP at least as often as commissioning meetings are being scheduled the status of each outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreement and proposals for their resolutions.
   a. The CxP retains the original non-conformance forms until the end of the project.
   b. Retesting shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

E. Failure Due to Manufacturing Defect: If 10% (or three (3), whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect not allowing it to meet its submitted performance specification, all identical units may be considered unacceptable by the Architect/Engineer or CxP. In such case, the Contractor shall provide the Owner with the following:
   1. Within one week of notification from the Owner, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Owner within two weeks of the original notice.
   2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated written explanation of the problem, cause of failures, etc., and all proposed solutions. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
   3. The Architect/Engineer will determine whether a replacement of all identical units or a repair is acceptable.
   4. Two examples, where applicable, of the proposed solution shall be installed by the Contractor and the Architect/Engineer shall be allowed to test the installations for up to one week, upon which the Architect/Engineer will decide whether to accept the solution.
   5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items at their expense. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.06 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the project completion level, required occupancy condition or other reason execution of checklists and performance testing may be delayed upon approval of the Owner and CxP. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxP shall coordinate this activity through the Owner. Tests will be executed by the contracting team and will follow the steps of pre-functional/startup checklists, Contractor-directed functional testing, and CxP-witnessed testing. Any final adjustments to the O&M manuals and as-built drawings due to testing shall be made by the Contractor.

3.07 OPERATING AND MAINTENANCE DATA

A. Operations and maintenance data shall cover all systems, equipment, devices, materials, and finishes described within these specifications and provided by Contractor under this project.

B. The CxP shall review the draft form of the O&M manuals provided by the Division 21, 22, 23, 25, 26 and 28 Contractors. The review process shall verify that O&M instructions meet specifications and are included for all commissioned equipment/systems provided by the Contractor, and that the information, instructions, and wiring diagrams are specific (edited where necessary) to the actual equipment provided for this Project.

C. The O&M manual review and coordination efforts shall be completed prior to Owner training sessions as these documents are to be utilized in the training sessions.

D. The CxP's review does not replace the Architect/Engineer's review of O&M manuals according to the Architect/Engineer's contract.

E. O&M Data Format:
   1. O&M data shall be provided in neatly indexed, heavy duty, vinyl, 3-ring binders of manageable size. Binders shall be indexed by specification section with additional dividers provided under each specification section if multiple types of equipment and/or systems are defined within a single specification section. Dividers shall be heavy paper with plastic covered tabs.
   2. Fold all oversized sheets to neatly fit within binder. For sheets greater than 11"x17" provide inserts for storage in binder.

3. Provide a table of contents in each binder. If more than one binder is used, clearly identify in the table of contents which information is contained in each binder.
4. Clearly label each manual with the title “OPERATION AND MAINTENANCE MANUAL - VOLUME _ OF _” and the project name.

F. O&M Data Content:
1. For the BMS system include the following in the O&M manuals:
   a. General/Hardware:
      1) Description of the system including definitions, size, architecture and functionality of each component of the system.
      2) As-built drawings for the system; control diagrams, wiring diagrams, system schematics, etc.
      3) Hardware component manufacturer’s specifications, installation instructions, operating and servicing instructions.
      4) Design data for sensors and control components external to digital controllers. Include manufacturer’s specifications, installation, maintenance, and calibration procedures.
      5) Output hardware data. Include manufacturer’s installation, maintenance and operations procedures.
      6) Step-by-step instructions to set controllers from installation to a point they can accept control programs from a computer. Include shop drawings showing cable connections and equipment settings for the operation of each controller.
      7) Interconnection wiring diagrams with system components and device identification.
      8) Step-by-step procedure for diagnosing and installing controller.
      9) Drawings: Project as-built drawings will be included in O&M manuals. Reduce to 11”x17” format, provide with reinforced punch binder tab. Bind with text; fold drawings to size of text pages. (Larger drawing will be allowed if 11”x17” is unreadable.)
      10) Include all submittals, product data and shop drawings updated to as-built conditions.
      11) Spare parts lists for each type of control device.
      12) Inspection period, cleaning methods, recommended cleaning materials and calibration tolerances.
   b. Software:
      1) Include step-by-step procedures for uploading and downloading of software programs from and to each controller and the operator station computer.
      2) Include documentation for software setup of every physical and virtual point. Include point name, location, type, and any other characteristic to define point.
      3) Include step-by-step procedure for making set point and equipment scheduling changes.
      4) Include documentation describing running and analyzing controller diagnostics.
      5) List alarms and messages programmed into each controller.
      6) Provide PID Loop turning procedures for the control system.
      7) Include step-by-step procedure for loading operator station software and accessing the control system.
      8) Documentation for creating, editing and using graphics.
      9) Sequences of operation in English narrative and graphic chart format. Sequences to include normal, emergency and failsafe modes of operation.
      10) Include all software documentation updated to as-built conditions.
   c. Provide two (2) copies of all job software on electronic format which can be directly loaded by the Owner.

3.08 TRAINING OF OWNER'S OPERATING PERSONNEL

A. Owner Training shall consist of well-produced MP4-formatted video recorded sessions of in-person live training sessions held and recorded for training of appropriate project team members. Training videos shall be:
   1. Edited & Narrated in clearly spoken English (unless alternate local language as-requested)
   2. Training videos shall be recorded and delivered to Owner on good-quality high-capacity solid-state-memory USB flash-drives (as opposed to Internet-based file or video sharing sites)
   3. Color-Coded Labels where appropriate corresponding to O&M Manuals
   4. Bookmarked and Sectioned into the following aspects of each major equipment piece:
      a. Equipment Components Identification
      b. Equipment Safety
         1) Lock-Out Procedures
         2) Emergency Shut-Off
         3) Safe Operating & Maintenance Procedures
      c. Normal Operating Sequences
      d. Service & Maintenance Operating Sequences
         1) Periodic Maintenance
         2) Major Service
      e. Other Pertinent Operational, Safety & Maintenance related items that can be live-demonstrated.
   5. Training videos shall be transmitted as a color-coded and labelled complete set of all facility equipment on USB flash-drives in quantities above.
   6. The Base Building Team and RME will be responsible for coordinating the training logistics with the CM/GC and storage of the electronic files.

3.09 ELECTRICAL PREREQUISITES

A. A circuit breaker coordination study must be complete with all breakers set in accordance with the study, and a copy of the report transmitted to the commissioning Provider a minimum of two (2) weeks prior to functional testing.

B. All electrical equipment shall have basic testing by the electrical test agency prior to energizing any portion of the system in accordance with the National Electrical Testing Association's "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems".

3.10 LOAD BANK REQUIREMENTS

A. Generators: Sufficient resistive load banks shall be provided in order to apply 100% rated load to each of the generators during functional testing. House load bank may be used if available during commissioning.

B. All required load banks of the correct size (kW/kVA), voltage, discharge type, with cable of sufficient size and length, prior to start of FPTs and IST.

3.11 TYPES OF LOAD BANKS

A. It is important to remember that this document is outlining a specific load in a specific location and that larger sized load banks may not reduce the total number of load banks required. It is also important to note that load banks are normally rated for a certain load at given voltage. Since the behavior of resistive load banks requires that the amount of load drawn will decrease as the voltage decreases and this needs to be taken into account when figuring out exactly how many load banks and cables will be required.

B. All load banks to be placed indoors need to be side discharge or have hoods installed to convert them into side discharge. Top discharge load banks will not be allowed for any indoor use.

3.12 RECORD DOCUMENTS

A. The Contractor shall maintain at the site one (1) record copy of all drawings, specifications, addenda, approved shop drawings, change orders, and other modifications in good order and marked to record all changes applicable to the work made during construction. All changes

from design made during construction shall be recorded by the Contractor. Contractor shall be responsible for sufficient detail and accuracy of all changes made.

B. Contractor record documents will be periodically reviewed and verified during construction by the CxP. Discrepancies in the record documents will be documented in site visit reports and the Contractor shall be responsible to verify and correct the record documents against the installed system for specified and all similar problems noted.

C. Contractor shall supply a draft copy of complete record documents to the Architect/Engineer and Owner prior to initial training session.

3.13 WARRANTIES

A. Contractor shall supply a complete copy of all warranties applicable to the project, the terms of maintenance for each warranty, and the inception and expiration dates for each warranty. This information will become part of the O&M data.

B. The CxP shall conduct a review of the operations and condition of the facility with Owner operating personnel with respect to warranty related issues. CxP shall supply Contractor, Architect/Engineer and Owner with a detailed report listing the issues identified. This report shall include at a minimum the following:
   1. Description of issue identified, including photographs as applicable.
   2. Recommended course of action.
   3. Supplementary information relative to previous maintenance or repairs attempted for resolution of issue.

C. Contractor shall plan to attend a warranty review meeting with CxP at site with Owner.

D. Architect/Engineer shall issue a formal course of action to Contractor for resolution of issues identified.

E. Contractor shall employ services and materials necessary for compliance to action statement from Architect/Engineer. All repairs and actions taken by Contractor shall be coordinated with Owner, with a formal log of work completed provided to Owner, Architect/Engineer and CxP at completion of all warranty work.

3.14 EXCLUSIONS

A. Responsibility for Construction Means and Methods: The CxP is not responsible for construction means, methods, job safety, or any construction management functions on the job site.

B. Hands-On Work by the Commissioning Provider: The Contractor shall provide all services requiring tools or the use of tools to startup, test, adjust, or otherwise bring equipment and systems into a fully operational state. The CxP shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

END OF SECTION

SECTION 02 3200
SUBSURFACE CONDITIONS

PART 1 - GENERAL

1.01 EXISTING CONDITIONS:

A. The Contractor shall visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedule and arrangements approved in advance by the Owner.

1.02 SUBSURFACE CONDITIONS:

A. A subsurface investigation report obtained for use in the design of pavement and foundations is available for reference: Geotechnical Engineering Report, Pender Commerce Park - BASF Plant Site, Pender County, North Carolina, prepared for Seefried Industrial Properties, prepared by TS&ME, Inc., Job Number 218721, dated October 15, 2021.
   1. Contractor shall assume responsibility for any conclusions drawn from the data.
   2. Data on indicated subsurface conditions are not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that the Owner and his consultants will not be responsible for interpretations or conclusions drawn therefrom by the Contractor.
   3. Data are made available only for the convenience of Contractor. The Contractor shall perform any additional subsurface investigation necessary to completely familiarize and satisfy himself as to the existing conditions at no cost to the Owner.
   4. The Contractor should visit the site and acquaint himself with the site conditions.

END OF SECTION

SECTION 03 1000
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.02 RELATED REQUIREMENTS

A. Section 03 1500 - Slab on Ground Accessories:

B. Section 03 2000 - Concrete Reinforcing.

C. Section 03 3000 - Cast-in-Place Concrete.

D. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.03 REFERENCE STANDARDS

A. The referenced standards are to be the latest editions adopted at project bid date.
   1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   2. ACI 301 - Specifications for Structural Concrete.
   3. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
   4. ACI 347R - Guide to Formwork for Concrete.
   5. PS 1 - Structural Plywood.

1.04 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 347, ACI 301, and ACI 318.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.

C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

A. Softwood Plywood: PS 1, C Grade, Group 2.

B. Lumber: Southern yellow pine species; No 2 grade; with grade stamp clearly visible.

2.03 REMOVABLE PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated.

D. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set, thickness as described on structural drawings.

2.04 FORMWORK ACCESSORIES

A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.

B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

C. Form Release Agent: Colorless mineral oil that will not stain concrete.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

E. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 1200.

F. Waterstops: Preformed mineral colloid strips, 3/8 inch thick, moisture expanding.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Except for floor slabs, construct bulkheads with keys at separation of pours except as otherwise noted on drawings. Locations of bulkheads shall be as indicated on approved shop drawings.

F. Slab on Ground Edge Forms: Wood bulkheads for slab forms shall be cut true and straight with an angled top surface tapering down and away from slab at a 15 degree angle. Use of Stryofoam blocks as a slab edge form shall not be permitted.

G. Coordinate this section with other sections of work that require attachment of components to formwork.

3.03 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Locate and set in place items that will be cast directly into concrete.

B. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

C. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.

3.05 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.06 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION

SECTION 03 1500
SLAB ON GROUND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes slab on ground dowel system.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

A. A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   2. ACI 360 - Design of Slabs-on-Ground.
   3. ASTM A36/A36M - Standard Specification for Carbon Structural Steel

1.04 SUBMITTALS

A. Product Data: Provide product data on all products including manufacturer's installation requirements.

B. Reports: Independent pull-out testing of the dowel debonding agent must demonstrate a required pull-out force of less than 1,000 lbs per load plate.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Acceptable manufacturers for plate dowels and dowel aligner:
   1. PNA Construction Technologies
   2. No Substitutions.

2.02 MATERIALS:

A. Smooth plates and bars, manufactured from steel meeting ASTM A 36/A36M.

B. Load plates and bars must have smooth and true edges. Acceptable methods of manufacture are saw or plasma cut and deburred. If sheared, manufacture must demonstrate that all edges will be deburred, and smooth and true without any deformity that may induce restraint of the slab.

2.03 CONSTRUCTION JOINT DOWELS:

A. All formed construction joints at the slab-on-ground shall be doweled.

B. Acceptable Products:
   1. Plate Dowel: PNA Construction Technologies (800-542-0214): Diamond Dowel Plates.
      a. Diamond Dowel Plate: See plate and size noted on drawings.
      b. Spacing: As noted on drawings.
      c. Accessory: High density plastic pocket former.
   2. Round Dowel:
      a. Smooth round bars with size and spacing as noted on drawings.
      b. Accessory: PNA Dowel Aligner.

2.04 SAWN CONTRACTION JOINTS:

A. Sawn contraction joints at the slab-on-ground shall incorporate dowel baskets where noted on drawings.

B. Acceptable Products:
   1. PNA Construction Technologies (800-542-0214):
      a. PD3 Tapered Plate Dowels: Steel plate and size as noted on drawings.
      b. Spacing: As noted on drawings.

C. Basket: Fully welded wire basket assembly, fabricated from 1/4 inch diameter cold drawn wire. Eight gauge wires shall be welded across the side frames at approximately 3 feet on center to

keep the assembly stable during shipping and installation.. Dimensions as required to locate dowel at mid-point of slab.

D. The load plates shall be delivered to the jobsite with a thin and consistently applied debonding agent of a maximum thickness of 0.002 inch. Greasing plates in the field is not acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Slab on Ground Dowels:
   1. Place all joint reinforcement products in accordance with the manufacturer's installation details, utilizing all alignment tools available.
   2. Install dowels perpendicular to joint and parallel to finished concrete surface.
   3. Dowel alignment shall be within ACI 117 tolerance allowance.
   4. Do not grease smooth round bars or plate dowels.

3.02 CONSTRUCTION JOINTS

A. Mark center point for spacing of each load plate on top of wood form along entire length. Set forms along construction joints. Place pocket former up to within 6 inches of joint intersection and a maximum of 12 inches to ensure positive load transfer at all joint intersections.

B. Install plastic pocket former sleeve insert to slab edge form at mid slab depth using the installation template included in each box of Diamond Dowel® pocket formers or the Diamond Dowel® bulkhead that can be purchased independently from PNA. After the form is removed, insert steel plate prior to adjacent slab placement.

C. Insert load plate into slot created by pocket former. Center corner of plate in middle of label and push straight through label into pocket former. Do not hammer or use excessive force to insert load plate. Insert load plate within three days of concrete placement.

D. For smooth round dowels use PNA Dowel Aligner in wood forms to assist in dowel alignment.

3.03 SAWN CONTRACTION JOINTS:

A. At reinforced slabs, provide typical slab reinforcing continuously through contraction joints. Reinforcing size and spacing per structural drawings.

B. At unreinforced slabs, provide Dowel Baskets:
   1. Locate control lines on base material or vapor retarder prior to slab placement for accurate placement of plate basket assembly, centered on joint. Basket shall be fabricated to place load plate at mid slab depth. Do not cut temporary cross wires.
   2. Baskets shall be fully welded assemblies fabricated to best suit the joint layout. Assemblies that require more than 5 percent of the assemblies to be cut onsite will not be allowed. No basket with less than 3 plates shall be used.
   3. The number of load plates in the welded assembly at the specified spacing must place the end load plates as close as possible to 6 inches from the joint intersection and in no instance more than 18 inches from the joint intersection.
   4. Stake baskets securely in place to prevent shifting during concrete placement. Basket assemblies placed on vapor retarders must be staked or taped to the vapor retarder with special tape for this application to ensure positive alignment during construction. The stakes shall be installed through mastic to maintain the integrity of the vapor retarder.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000, will inspect installed accessories for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 2000
CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for cast-in-place concrete.

B. Supports and accessories for steel reinforcement.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories.

B. Section 03 1500 - Slab On Ground Accessories.

C. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

A. A. Referenced standards are to be the latest editions adopted at project bid date
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
   3. ACI 360R- Guide to Design of Slabs-on-Ground
   4. ACI SP-66 - ACI Detailing Manual.
   5. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   6. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   7. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   8. CRSI (DA4) - Manual of Standard Practice.

1.04 SUBMITTALS

A. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

PART 2 PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), or ASTM A706/706M, Grade 60 (60KSI).
   1. Deformed billet-steel bars.

B. Stirrup Steel: ASTM A1064/A1064M steel wire, unfinished.

C. Steel Welded Wire Reinforcement (WWR): Where noted on Drawings, Deformed type; ASTM A1064/A1064M.
   1. Mesh Size and Wire Gage: As indicated on drawings.

D. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice and ACI 318.

B. Welding of reinforcement is only permitted as indicated on drawings and with ASTM A706 weldable reinforcing steel.

PART 3 EXECUTION

3.01 PLACEMENT

A. Reinforcement, at the time concrete is placed, shall be free from rust scale, oil and other coatings reducing bond. Use no bars with kinks or bends not shown on placement drawings.

B. Place, support and secure reinforcement against displacement. Do not deviate from required position.

C. Accommodate placement of formed openings.

D. Protective concrete cover over reinforcement shall be as indicated on the drawings.

E. Install welded wire reinforcement in sizes and locations indicated.
   1. For plain (non-deformed) welded wire, lap joints one wire spacing plus 2".
   2. For deformed welded wire reinforcement, lap joints as detailed on drawings.

F. Conduit and Pipes: Concrete cover shall be equal to cover for reinforcing bars. Embedded conduit diameter shall not exceed 1/3 slab or wall thickness. Tie down low conduit on top of bottom reinforcing bars. Space no conduit less than three diameters apart and minimum 1" separation from parallel reinforcing bars. Use no aluminum conduits or couplings in concrete.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000, will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete foundations.

B. Suspended concrete slabs.

C. Concrete floor slabs on ground.

D. Joint devices associated with concrete work.

E. Miscellaneous concrete elements, including equipment pads, light pole bases, and flagpole bases.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 01 4000 - Quality Requirements: Testing and inspection.

C. Section 01 4540 - Concrete Testing - Random Traffic Areas Floor Flatness and Levelness Testing (Ff - Fl).

D. Section 01 4545 - Concrete Testing - Gloss Testing for Slabs Subjected to Robotic Equipment

E. Section 01 4555 - Concrete Testing - Roughness (Ra) Testing for Slabs Subjected to Robotic Equipment

F. Section 03 1000 - Concrete Forming and Accessories.

G. Section 03 1500 - Slab on Ground Accessories.

H. Section 03 2000 - Concrete Reinforcing.

I. Section 03 3560 - Concrete Floor Finishing.

J. Section 03 3565 - Interior Concrete Polishing (No Dye).

K. Section 03 4713 - Tilt-Up Concrete

L. Section 03 4714 - Tilt-Up Concrete - Insulated

M. Section 07 2616 - Vapor Retarder

N. Section 07 9200 - Joint Sealants: Sealants for saw cut joints and isolation joints in slabs.

O. Section 07 9216 - Interior Floor Joint Filler and Sealant

1.03 REFERENCE STANDARDS

A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   2. ACI 301 - Specifications for Structural Concrete.
   3. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
   4. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete
   5. ACI 305.1 - Specification for Hot Weather Concreting
   6. ACI 306.1 - Standard Specification for Cold Weather Concreting.
   7. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
   8. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
   9. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   10. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
   11. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   12. ASTM C150/C150M - Standard Specification for Portland Cement.
   13. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete.
   14. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Mix Designs: Submit mix designs for each type and class of concrete to the Architect.
   1. Designation, type, geology, quality, and source (natural or manufactured) of coarse and fine aggregate materials.
   2. Shrinkage Test Reports.
   3. Sieve Analysis Reports: Provide separate sieve analysis of percentages passing for each proposed coarse and fine aggregate group. Despite what ASTM C33 allows, do not skip any sieve. Provide recent running/rolling average sieve analysis (number of tests, dates, etc.), or at least the last 5 tests, for each submitted aggregate group and size group (i.e. #57 stone, natural sand, manufactured sand, etc.). Sieve analysis sampling and testing for each aggregate group and source shall be conducted within 60 days of concrete submittal date.
   4. Aggregate Supplier Statement;
      a. Stating if aggregate is possibly alkali-reactive, based on tests and past service.
      b. Stating if aggregate can possibly cause pop-outs, "D" cracking, or other disruptions due to moisture gain, freezing, or other mechanisms, based on tests and past service.

C. Placing Drawings: Provide placing plan depicting layout and sequencing of slab pours for Owner approval. Include horizontal and vertical construction joint locations, contraction joint spacing, temporary block-outs and openings for equipment access.

D. Pre-qualify ready-mixed concrete suppliers according to the requirements of ASTM C94.

E. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Acquire cement from same source and aggregate from same source for entire project.

1.06 MOCK-UP

A. Mock-Up Slab on Ground:
   1. Thickness and mix design representative of project design
   2. To include:
      a. Vapor retarder/barrier
      b. Dowel baskets
      c. Construction joint dowels
      d. Curing compounds
      e. Admixtures required for project
   3. Finish slab to meet project specifications
   4. Cut contraction joints
   5. Mock-up may not remain as part of the Work.
   6. Size: Minimum 20 foot x 20 foot

B. Mock-Up Suspended Slab
   1. Thickness and mix design representative of project design
   2. To include:
      a. Fiber in mix, amounts as specified
      b. Curing compounds
      c. Admixtures required for project
   3. Place concrete via pump with longest slickline and hose length anticipated in execution of actual work
   4. Finish slab to meet project specifications
   5. Mock-up may not remain as part of the Work.
   6. Size: Minimum 20 foot x 20 foot

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT

A. For steel reinforcement, comply with requirements of Section 03 2000.

B. For macrosynthetic fiber reinforcement comply with this Section.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I, I-II, II, II-V or V. Normal Portland Cement.

B. Normal Weight Aggregate: Fine and coarse aggregate meeting ASTM C33 except as modified herein.
   1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that can cause pop-outs or other disruptions.
   2. For slab-on-ground and suspended slab design mix, conform to the following:
      a. Gradation requirement of ASTM C33 may be waived in order to meet ranges specified. The conformance with the combined aggregate gradation requirements is of higher priority than meeting ASTM C33 aggregate gradation tolerances alone.
      b. Nominal top size coarse aggregate required in mix design shall be 1-1/2 inch (#4 stone) for slab on ground and 1 inch (#57 stone) for suspended slab.
      c. Adjust proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution characteristics, unless otherwise approved:
         1) Coarseness Factor of 60 to 75%.
            (a) The Coarseness Factor (CF) is the percent of combined aggregate retained on the #8 sieve that is also retained on the 3/8" sieve.
            (b) The Coarseness Factor is calculated as follows: CF = Aggregate retained on 3/8" sieve / Aggregate retained on #8 sieve.
         2) Adjusted Workability Factor:
            (a) The Workability Factor (WF) is the percent of combined aggregate that passes the #8 sieve.
            (b) The Adjusted Workability Factor (Adj-WF) is calculated as follows: Adj-WF = WF + [(Cementitious Material - 564 lbs) / 37.6].
            (c) The range of accepted Adj-WF for a given CF is as follows: Adj-WF = [(11.25 - .15 CF) + 35] +/- 2.5.
      d. Of total combined coarse and fine aggregates per mix design, do not allow material retained on any one sieve to be less than 8% nor more than 18% of total by weight, except for largest sieve plus Nos. 100 and 200 sieves.
      e. Maintain percent of total combined aggregates retained on largest sieve at 1% to 4%.
      f. Maintain percent of total combined aggregates retained on No. 100 sieve at 1.5% to 5% and on No. 200 sieve at 0% to 1.0%.
      g. Total of No. 100 and 200 sieves plus pan to be 3% to 8%.
      h. For actual field samples ensure total combined aggregates conform to limits specified herein.
      i. Accepted deviations from the above combined gradation are as follows:
         1) Never shall three (3) adjacent sieve sizes fall below 8% retained.
         2) Never shall two (2) adjacent sieve sized fall below 5% retained.

C. Aggregate used for slab-on-ground and suspended slab mixes shall have proven shrinkage characteristics of less than 0.04% in accordance with ASTM C 157 as modified herein.
   1. Document slump, air, and temperature of the mixture at the time of mixing - attempt to simulate field conditions.
   2. The test mix should include any/all admixtures anticipated at the dosage anticipated. If multiple dosages are possible, test mixes including each potential dosage or test mixtures

including the high and low range of the potential dosage. Three beams are required for each mixture.

3. The test beams should be 4 in. x 4 in. x 11¼ in. as 1½ in. aggregate is included in the mix - Section 7.2 of ASTM C-157. Record consolidation procedure.
4. In lieu of the specified 28-day soak in lime-saturated water bath, moist-cure beams in moist room maintained at 100% RH for a period of 7 days. Other than this modification, follow the procedure in Section 10.2 to record the initial comparator reading.
5. After curing, store beams dry (50% RH and 73 °F as specified in Section 11.1.2 of ASTM C-157) and record length measurements using the same comparator used for the initial reading at 3, 7, 14, 21, and 28 days. Document each sample length measurement as well as its initial measurement.
6. Continue storage of samples and record additional verification length measurements at 8, 16, 32, and 64 weeks in accordance with Section 11.1.2 of ASTM C-157.
7. At each test age, report results in accordance with Section 13 of ASTM C-157. Report should include mixture proportions, data for each sample, and ambient conditions of storage room during drying period.

D. Fly Ash: Class F or C per ASTM C 618, except loss on ignition to be 3% maximum.
   1. Use of fly ash permitted only for the following conditions:
      a. In foundation concrete.
      b. If Type V cement is unavailable or is insufficient to mitigate by itself, then fly ash can be used to mitigate sulfate exposure or as a means of mitigation of significant potential aggregate reactivity. To mitigate potential aggregate reactivity, the fly ash is to have the following properties.
         1) Maximum 1.5% available alkali.
         2) Maximum 8% CaO

E. Ground-Granulated-Blast-Furnace Slag (GGBF) per ASTM C 989, Grade 120 or 100.
   1. Use of slag permitted only for the following conditions:
      a. In foundation concrete.
      b. If Type V cement is unavailable or is insufficient to mitigate by itself, then slag can be used to mitigate sulfate exposure or as a means of mitigation of significant potential aggregate reactivity.

F. Water: Clean and not detrimental to concrete.

G. Suspended Slab - Structural Fiber Reinforcement: ASTM C1116/C1116M.
   1. Include 7.5 pcy in locations noted on Drawings.
   2. Manufacturers:
      a. Forta Corporation; FORTA-FERRO: www.forta-ferro.com.
      b. Euclid Chemical Company; TUF-STRAND SF: www.euclidchemical.com/#sle.
      c. Substitutions: Not permitted.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Air Entrainment Admixture: ASTM C 260.

C. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, and Type E - Water Reducing and Accelerating - Type F - Water Reducing, High Range Latest Generation Polycarboxylate -Type.
   1. Type F Admixture shall be equal to Glenium 7500 by BASF.

2.05 JOINTING PRODUCTS

A. Pre-molded Expansion Joint Filler: Resilient, flexible, nonextruding, expansion-contraction joint filler. Cellular fibers securely bonded together, uniformly saturated with asphalt.
   1. Acceptable Product: W. R. Meadows; Fibre Expansion Joint, with "Snap-Cap" expansion joint cap.

2. Thickness: 1/2 inch unless noted otherwise.

B. Foam Plank Joint Filler: Closed cell, resilient, flexible, full-depth of slab:
1. Acceptable Products: W.R. Meadows, Deck-O-Foam or Ceramar
2. Thickness: As noted on Drawings.

2.06 MIX DESIGNS:

A. Design mixes to provide normal weight concrete with the following properties:
1. Footings:
   a. 28-Day Strength: 3,000 psi minimum, unless otherwise indicated on structural drawings.
   b. Maximum aggregate size: 1 1/2 inch
   c. Slump Range: 4 inch +/- 1 inch maximum.
   d. Admixtures: None required.
2. Interior Slab-on-Ground:
   a. 28-Day Strength: 4,000 psi minimum.
   b. Minimum cement content 520 pounds.
   c. Top Required Nominal Required Aggregate Size: 1 1/2 inches (#4 or #467 stone).
   d. Max. W/C Ratio: 0.55.
   e. Slump Range:
      1) 5 inch +/- 1 inch maximum at delivery for tail-gate placement. Concrete with a slump as measured per ASTM C143 exceeding 6 inches at the point of deposit on the sub-base shall be rejected.
      2) If pumped, slump shall be measured at delivery, which is between the transport vehicle chute and the pump hopper. Slump range measured at delivery for pumped concrete shall be 6 inch +/- 1 inch maximum, unless otherwise approved by Engineer.
   f. Admixtures:
      1) Water-reducing, 6 oz./100 lbs. cement max.
      2) Accelerating permissible when ambient air temperature less than 40 degrees F, quantity as approved by Engineer.
   g. Time of Setting: Initial setting time shall not exceed 400 minutes as determined by ASTM C 403 for a laboratory sample representing the submitted mix design, admixture dosages, and concrete temperature of 60 degrees F +/- 5 degrees F. Only one specimen or time of setting test is required per sample. If more than one test is performed per sample, report average times of initial setting. Test shall be performed by an independent testing agency selected by, and as a responsibility of, the Concrete Supplier.
   h. Blended natural and manufactured sand shall have at least 70% natural sand, unless otherwise approved by Engineer.
3. Suspended Slabs:
   a. 28-Day Strength: 3,500 psi minimum.
   b. Top Required Nominal Aggregate Size: 1 inch (#57 stone - pump mix).
   c. Top Required Nominal Aggregate Size: 1 inch (#57 stone - pump mix).
   d. Max. W/C Ratio: 0.55.
   e. Slump Range: 6 inch +/- 1 inch maximum, at point of final placement.
   f. Admixtures:
      1) Water-reducing High Range, 5-10 oz./100 lbs. cement max.
      2) Accelerating permissible when ambient air temperature less than 40 degrees F, quantity as approved by Engineer.
   g. Blended natural and manufactured sand shall have at least 70% natural sand, unless otherwise approved by Engineer
4. Tilt-up Wall Panels:
   a. 28-Day Strength: minimum 4,000 psi, unless indicated otherwise on structural drawings.
   b. Top Required Nominal Aggregate Size: 1 inch (#57 stone).

c. Max. W/C Ratio: 0.52.
d. Slump Range: 5 inch +/- 1 inch, at point of final placement.
e. Admixtures:
   1) Water-reducing, 6 oz./100 lbs. cement max.
   2) Accelerating permissible when ambient air temperature less than 40 degrees F, quantity as approved by Engineer.

B. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to, and accepted by, Engineer before using in Work.

2.07 SLAB ON GROUND BASE MATERIAL

A. Coarse aggregate base: Crusher run with rock fines. Use ASTM D 448 NO. 467, 57 OR 67 blend only if noted or allowed.

B. Fine aggregate Base: Clean screenings ASTM D 448, NO. 10 with 6% TO 12% passing NO. 200 sieve. Compact with a minimum of two passes with a vibratory plate compactor.

PART 3 EXECUTION

3.01 INSPECTION:

A. Pre-slab Meetings for Slabs on Ground and Suspended Slabs on Metal Deck: A minimum of 14 days prior to beginning concrete placement for each slab type, Contractor shall schedule meeting, as described in Section 01 3000 - Administrative Requirements, with Architect, Tenant's Concrete Consultant, Testing Agency, Concrete supplier, Concrete placing and finishing foreman and other affected subcontractors and material suppliers. Discuss mix designs, placing procedures, acceptability of formwork and reinforcement, acceptable tolerances and finishes, testing, curing and protection. Contractor shall be responsible for keeping minutes of meeting and distributing to attending parties.

3.02 BATCHING AND MIXING:

A. Batch, mix and transport in accord with ASTM C94, except where more stringent requirements are specified.

B. Delivery Tickets: Concrete producer shall furnish with each load of concrete a numbered delivery ticket showing Contractor, name and location of project, date and time batched, truck number, number of cubic yards in load, specified strength, slump and mix design number.
   1. Slab on Ground and Suspended Slab on Metal Deck Mixes: All delivery tickets shall be clearly marked to also show in gallons per cubic yard:
      a. The “maximum permitted water content”.
      b. The “actual batch water content” (including the water estimated to have been introduced by the aggregate).
      c. The “maximum permitted additional water for slump adjustment” (ie. the difference between the “maximum” and “actual” water contents).

C. Clean truck mixer drums prior to each batching of concrete and ensure washout water is accounted for in next batch. Load truck mixers at capacity that will ensure a uniform batch at slump specified. Reject non-uniform mixing.

D. Start mixing time after all ingredients are in mixer. Minimum mixing shall be 70 revolutions at mixing speed, if charged to maximum capacity; 50 revolutions at mixing speed, if charged to less than maximum capacity.

E. When concrete is delivered in a truck mixer or agitator, no additional water shall be added after the initial introduction of mixing water for the batch, except when on arrival at project site the slump of the concrete is less than that specified or as allowed herein for hot weather concreting. Such additional water (not to exceed the required water/cement ratio) may be added in accordance with ASTM C94 to bring slump within required limits, and shall be injected into the mixer. The drum or blades shall be turned an additional 30 revolutions or more at mixing speed until the concrete is within the proper slump limits.

F. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. Make additional set of cylinders if concrete is accepted 300 revolutions or after 1-1/2 hours per time acceptance criteria in ASTM C94.

G. Concrete shall be delivered at such a rate as will assure prompt discharge upon truck arrival. Place no concrete that has been discharged from mixer truck for longer than 30 minutes.

H. Reject truck mixers with unacceptable batches of concrete. Dispose of concrete legally and clean mixer prior to refill. Rejected mixers shall be tested by Testing Agency on new delivery for slump and mix tests.

I. Cause for rejection of concrete:
   1. Concrete exceeds allowable slump.
   2. Excessive air (over 3.0%) in concrete for troweled floor slabs, and in other instances where air exceeds project specifications.
   3. Concrete temperature at placement exceeds 95 degrees F.
   4. Concrete discharge exceeds 90 minute time limit unless waived by purchaser per ASTM C94 time acceptance criteria, and in other instances where concrete does not meet project specifications.

3.03 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.04 PREPARATION

A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

B. Install pre-molded expansion-contraction joint filler or foam plank joint filler full depth in accordance with manufacturer's instructions.
   1. Position joint filler against forms, at interrupting objects or columns, and against abutting structures before concrete placement.
   2. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Place expansion joint cap to flush with finished slab surface.
   3. Prior to installation of joint sealant, slide expansion joint cap off the expansion joint.
   4. Conform to Section 07 9216 - Interior Floor Joint Filler and Sealant for joint filler and sealant requirements.

C. Slab on Ground Base Material Installation:
   1. Compact coarse aggregate base to final thickness shown in layers not exceeding 6 inches, with minimum of 2 passes per layer with a vibratory compactor.
   2. Compact base to the specified maximum dry density as determined by the geotechnical engineer.
   3. Choke-off top surface of coarse aggregate base with fine aggregate base material due to the following:
      a. As required to meet fine grade elevation tolerances specified.
      b. Where coarse aggregate base material does not have sufficient fine particles to produce a surface that is free of exposed aggregate or surface voids immediately prior to slab installation.
   4. Compact fine aggregate base choke-off layer with a minimum of 2 passes with a vibratory compactor.
   5. Top surface of base material to be dry, smooth, flat, dense surface immediately before placing concrete

3.05 DEPOSITING CONCRETE:

A. All footing excavations shall be examined by the Geotechnical Engineer to verify that the design bearing pressure is available. All footings should be clean, level and free of ponding water. Since the soils tend to soften upon exposure, concrete should be placed as soon as is practical

after the footing is excavated. Any open footing shall be protected from weather conditions until reinforcing steel and concrete can be placed.

B. Slab on ground shall be placed on compacted base. Fine grade subbase using a laser controlled grading box and then roller compact to within ± 0 / -½ inch of final grade. A final examination of the subbase shall be performed by the Geotechnical Engineer immediately prior to placing floor slabs. If the exposed subgrade becomes wet or frozen, the surface shall be recompacted at the direction of the Geotechnical Engineer. The minimum compaction required unless noted otherwise is 98% of ASTM Specification D-698 (Standard Proctor Density). Proof roll each slab placement area on the day prior to slab installation using a loaded 40 GWT tandem axle truck. Proof roll multiple passes in two directions to simulate truck dumped concrete. Proof roll one pass in two directions for pumped in place concrete. Slabs shall not be placed over any base that visibly “pumps” or ruts more than ½ inch under such proof rolling. If pumping is encountered, Contractor shall make repairs as recommended by the Geotechnical Engineer at no additional cost to the Owner or extension of Contract Time.

C. Before placing concrete, inspect and approve formwork, reinforcement, sleeves and embedded items.

D. Maintain reinforcing in proper position on supports with sand plates or dobies with tie wires during concrete placement. Use sufficient supports to withstand construction loads. Hold reinforcing in place with not less than one support per 15 sf of slab area, unless drawings specify a closer spacing. Decrease spacing between supports if supported reinforcement deflects more than 1/2 inch from specified during placing activities.

E. Handle concrete from mixer to place of final deposit as rapidly as practical by methods that shall prevent segregation or loss of ingredients. Distribute concrete by means of equal to a steep sided bottom drop concrete bucket. Allow no concrete to free-fall over 4 foot - 0 inch. Utilize buckets with a capacity of not less than 1/2 cu. yd. Clean transporting and handling equipment at frequent intervals and flush with water before and after each day's run. Discharge no water into concrete forms.

F. Place no concrete in forms after initial set has taken. Re-tempering of concrete that has partially set is prohibited. Place no concrete while temperature or other environmental conditions or limitations of facilities prevent proper finishing and curing.

G. Deposit concrete as near final position as possible to avoid re-handling. Place concrete in forms with uniform horizontal layers 1 foot - 6 inch to 2 foot - 0 inch in depth; avoid vertical joints or inclined planes. Do not permit piling up of concrete in forms in a manner to permit escape of mortar or flow of the concrete. Deposit concrete continuously with thorough consolidation by vibrating to insure a dense, homogeneous mass without voids or pockets.

H. Transport and place pumped concrete in accord with ACI 304 requirements. Brace formwork to handle effects of pump hammer. Employ aggregates of controlled water contents for pumped concrete. Use no aluminum pipes for transporting concrete. Equipment used to transport concrete shall be compatible with concrete reinforcement and desired finishes.

I. All suspended slabs with W-Shape floor framing are to be placed and finished to a uniform thickness. Laser guided screed strike-off is acceptable. At the contractor’s option, a “level” slab surface can be placed instead of providing a constant thickness slab.

J. All suspended slabs with composite joist floor framing are to be placed and finished to a level elevation. Pre-load with concrete the entire slab bay and then deposit additional concrete as necessary to do this before final slab strike-off, while ensuring minimum specified slab thickness over girders and beams.

3.06 TOLERANCE:

A. Concrete floor slabs shall have cross-sectional dimensional tolerance per ACI 117, except suspended slabs have a thickness tolerance of -1/2 inch.

3.07 CONSOLIDATION:

A. Use vibrators for concrete consolidation. Place vibrators in concrete rapidly to penetrate into previous lift blending two layers and minimizing or eliminating entrapped air between concrete and form.

B. Use vibrators along slab-on-ground edge forms to properly consolidate concrete around construction joint reinforcement dowels. Vibrator head shall not be allowed to come within 3" of form face.

C. Use vibrators with steady, continuous motion in concrete mass and for long enough duration at each position in a pattern to permit maximum escape of air from concrete.

D. Vibrators shall be 2-1/2 inch to 2-5/8 inch in diameter with minimum frequency of 10,000 impulses per minute. Furnish number of vibrators as required to vibrate all concrete immediately upon placing. Maintain spare vibrators at project site in case of breakdown. Use and type of vibrators shall conform to ACI 309 "Recommended Practice for Consolidation of Concrete".

3.08 COLD WEATHER CONCRETING:

A. Take cold weather precautions when temperature on job site is below 40 degrees F., in accord with ACI 306.1. Accelerators, if used, shall be added at the concrete producer's plant in accord with approved mix design.

B. Heat water, aggregates or both to maintain the temperature of the concrete at the time of delivery at not less than 65 degrees F for slabs and 55 degrees F for other concrete. Provide tarps, heaters, insulated forms or other means to maintain the temperature of deposited concrete at not less than 55 degrees F. for the recommended length of protection period, for concrete placed during cold weather. For troweled slabs do not allow base or form to be more than 20 degrees F colder than concrete at delivery.

3.09 HOT WEATHER CONCRETING:

A. Concreting in Hot, Dry and/or Windy Weather:
   1. Conform to ACI 305.1 when any combination of high air or concrete temperature, low relative humidity, and wind velocity tend to impair quality of concrete.
   2. Employ special precautions when evaporation rate as obtained from ACI 305.1 is expected to reach 0.10 pound per square foot per hour or more.
   3. Unless otherwise allowed, reject concrete if its temperature before placement is over 95F.
   4. Do not place concrete when forms, subgrade, base, or reinforcing bars are more than 120F or more than 10F hotter than ambient air temperature.
   5. Cool with water or water-soaked burlap as necessary, but allow no standing water on surface on which concrete is placed.

B. Retarders, if used, shall be added at concrete producer's plant in accord with approved mix designs. Where necessary, cool aggregates or use chilled water or both to maintain concrete temperature as delivered to the job site below 90 degrees F.

C. In hot weather, up to 10% of design mix water (not to exceed the required water/cementitious material ratio) may be added to truck mixers at job site to replace water lost by evaporation. Mix for minimum of 30 additional revolutions after water is added. Make slump test and cylinders for compression test specimens from each truck to which water has been added. The additional cylinders shall not be counted in determining "frequency of testing" as defined in Concrete Testing section. Cost for additional testing shall be borne by Contractor.

3.10 FINISH OF FORMED SURFACES:

A. All exposed cast-in-place concrete shall be patched and rubbed smooth. All fasteners and form ties shall be removed and holes patched. Repair and patch defective areas with fins or other projections completely removed and smoothed. Finish shall be flush and match adjacent surfaces.

3.11 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. See Section 03 3560 - Concrete Floor Finishing.

3.12 CONCRETE FINISHING

A. See Section 03 3560 - Concrete Floor Finishing.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed agency.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Testing Agency Duties:
   1. Review proposed mix designs for concrete classes specified.
   2. Review concrete materials for compliance with specifications. Obtain samples as required.
   3. Sample concrete at project site and prepare compressive strength test specimens, tests for slump, air content and unit weight.
   4. Maintain field test data sheet for each set of concrete specimens. The completed data sheet shall include laboratory number, date, plant, truck number, time batched, time sampled, air temperature, concrete temperature, inspector, mix design number, required compressive strength, unit weight, air content, slump, location of placement, seven day and 28 day strengths.
   5. Transport test specimens to Testing Agency's laboratory.
   6. Perform specified laboratory tests.
   7. Notify Architect immediately of any test specimens that do not meet design compressive strength at 28 days or 2/3 of design strength at seven days.
   8. Perform floor tolerance measurements and other floor surface testing noted in Sections 01 4540, 01 4545, 01 4550 and 01 4555.

E. Contractor Duties Regarding Testing Agency:
   1. Provide a space suitable for Testing Agency to store 1-6 day old cylinders that will not require continual movement during construction.
   2. If weather dictates, provide for Testing Agency an on-site curing space in accordance with ACI standards for storage of cylinders during cold weather concreting.

F. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
   1. Specimens may be 4x8 inch cylinders or 6x12 inch cylinders.
   2. When the frequency of testing will provide less than five acceptance tests for a given mix design, tests shall be made from at least five batches selected at random or from each batch.
   3. Perform acceptance testing using cylinders at 28 days.
   4. Compressive strength of concrete will be considered satisfactory if averages of all sets of three consecutive strength test results equal or exceed the required 28 day design compressive strength and no individual strength test result falls below design compressive strength by more than 500 psi.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

H. For trowel finished slabs, perform air test and unit weight test for first truck and thereafter every 100 cu yd or less of concrete placed. Reject concrete if air content is over 3.0% with the tested aggregate correction factor adjustment. Recheck air content if unit weight is over 3.0 pcf less than its theoretical weight per mix design.

3.14 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

END OF SECTION

SECTION 03 3560
CONCRETE FLOOR FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finishing slabs on ground and suspended slabs on metal deck.

B. Curing concrete surfaces.

C. Surface treatment with concrete densifier.

D. Grinding construction joints.

E. Concrete floor slab repairs.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting.

B. Section 01 4540 - Concrete Testing - Random Traffic Areas Floor Flatness and Levelness Testing (Ff - Fl)

C. Section 01 4545 - Concrete Testing - Gloss Testing for Slabs Subjected to Robotic Equipment

D. Section 01 4555 - Concrete Testing - Roughness (Ra) Testing for Slabs Subjected to Robotic Equipment

E. Section 03 3000 - Cast-in-Place Concrete:

F. Section 03 3565 - Interior Concrete Polishing (No Dye).

G. Section 07 9200 - Joint Sealants

H. Section 07 9216 - Interior Floor Joint Filler and Sealant

1.03 REFERENCE STANDARDS

A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ACI 301 - Specifications for Structural Concrete for Buildings.
   2. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
   3. ACI 308.1 - Standard Specification for Curing Concrete.
   4. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   5. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete.
   6. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.
   7. ANSI A326.3 – American National Standard Test Method For Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials.

1.04 SUBMITTALS

A. Product Data: Provide data on all products, including information on compatibility of different products and limitations.

B. American Concrete Institute (ACI) Certifications: Submit current ACI Flatwork Finisher certifications one month minimum before starting floor construction.

C. Slab repair procedures.

D. Slab surface roughness remediation procedures.

1.05 QUALITY ASSURANCE

A. Interior Slab-on-Ground and Slab on Metal Deck Installer: Construction of interior slabs shall be performed by Installer capable of achieving high quality control in finished product as measured in terms of surface flatness and levelness, uniformity in texture, smoothness, and appearance of hard steel troweled surfaces, precision in construction of joints, and minimization of slab shrinkage, plastic cracking, and edge finishing swale. Engage Installer, fully experienced in ways, means, methods and materials of slab-on-ground and suspended slab concrete

construction, capable of producing high quality finished product for this project, and as acceptable to Owner's representative.

B. Perform Work in accordance with standards referenced.

C. American Concrete Institute (ACI) Certifications: Floor contractor finishing crew shall have a minimum number of concrete finishers with the following current certifications.
   1. ACI Commercial-Industrial Flatwork Finisher: One.
   2. ACI Flatwork Finisher or Tradesman: Three.

D. Floor flatness and levelness for slabs
   1. Measure floor fatness and levelness per Section 01 4540
   2. The entire slab-on-ground and slab on metal deck shall be designated as a Random Traffic Floor.
   3. <u>Slab-on-ground floor slabs shall conform to the following F-number requirements:</u>
      a. <u>Specified Overall Value: Ff 50 / Fl 35.</u>
      b. <u>Minimum Local Value: Ff 35 / Fl 25.</u>
   4. <u>Suspended slab areas shall conform to the following F-number requirements (Note: that Fl levelness values do not apply to unshored suspended slab construction):</u>
      a. <u>Specified Overall Value: Ff 30.</u>
      b. <u>Minimum Local Value: Ff 19.</u>
   5. Additional slab elevation requirements:
      a. Slab elevation change shall not exceed ¼” over 2 feet-0 inches
      b. Vertical step transitions shall not exceed 120 mils (0.120 in.) adjacent to expansion joint after expansion joint installation.

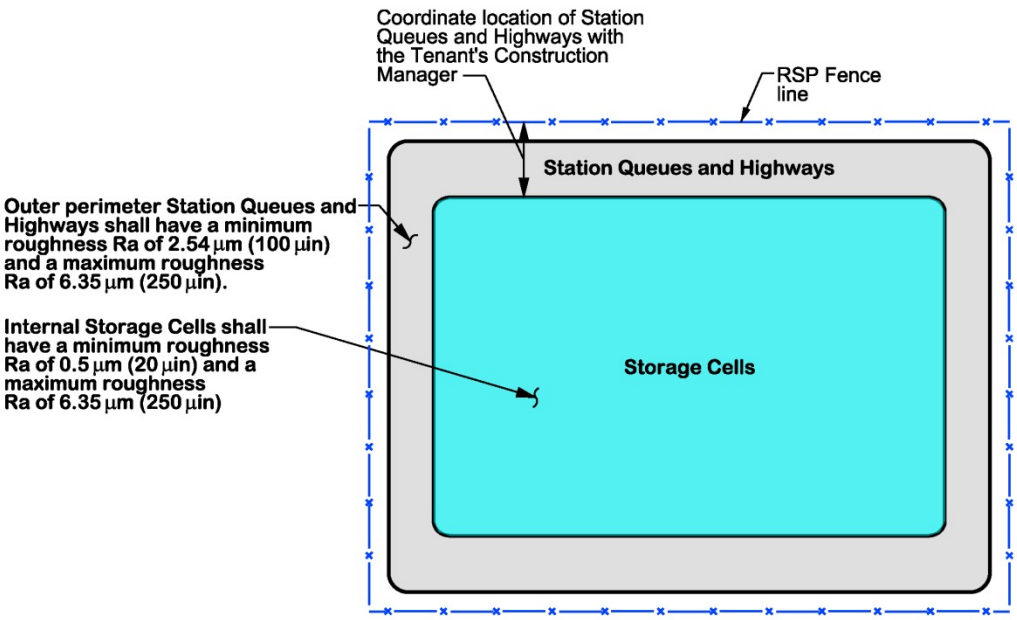
E. Gloss requirements for slab subjected to robotic equipment requirements:
   1. Measure gloss per Section 01 4545
      Notes to specifier: There are different gloss values that are to be used depending on the robotic equipment that will be used for the project. Select the appropriate gloss value selection and delete the equipment type in the brackets [xxx]
   2. *[H and P Systems]* Gloss values are to be a maximum of 60 at 85-degrees
   3. *[G and S Systems]* Gloss values are to be a maximum of 20 at 85-degrees

F. Slip Resistance for slabs subjected to robotic equipment requirements
   1. Measure slip resistance per 01 4550
   2. Floor surface to have a Dry Dynamic Coefficient of Friction (DCOF) of 0.50 or higher.

G. Roughness requirements for slabs subjected to robotic equipment requirements.
   1. Measure roughness per 01 4555

   Notes to specifier: There are different roughness values that are to be used depending on the robotic equipment that will be used for the project. Select the appropriate Ra value selection and delete the equipment type in the brackets [xxx]

H. *[G, S, and H Systems]* Roughness (Ra) requirements are to be as follows and shown in figure below:
   1. Outer perimeter Station Queues and Highways shall have a minimum roughness Ra of 2.54 µm (100 µin) and a maximum roughness Ra of 6.35 µm (250 µin).
   2. Internal Storage Cells shall have a minimum roughness Ra of 0.5 µm (20 µin) and a maximum roughness Ra of 6.35 µm (250 µin).
   3. Coordinate location of Station Queues and Highways with the Tenant’s Construction Manager.



SURFACE ROUGHNESS LOCATION FIGURE

4. Sortation Mezzanine, same as Internal Storage Cells.

I. *[P System]* Roughness (Ra) requirements are to be a minimum 2.54 µm (100 µin) and a maximum 6.35 µm (250 µin).

J. Remedy for out-of-tolerance work:
   1. All Minimum Local Floor Sections measuring at or above both of the specified minimum local F-numbers shall be accepted for tolerance compliance as constructed. All Minimum Local Floor Sections measuring below either of the specified minimum local F-numbers shall be removed and replaced for slab on ground and shall be ground into tolerance as directed by the Owner's Representative for slabs on metal deck.
   2. Slab areas that exceed the maximum elevation change of 1/4-inch within 2 feet of vertical elements shall be ground into tolerance as directed by the Owner's Representative.
   3. Vertical step transitions that exceed 120 mils (0.120 in.) adjacent to expansion joint after expansion joint installation shall be ground into tolerance as directed by the Owner's Representative.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 PROJECT CONDITIONS

A. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
   1. No motorized vehicles will be allowed on slabs without proper protection for wheels and oil or hydraulic reservoirs to eliminate oil drips and avoid staining of the concrete.
   2. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, impervious drop cloths will be placed under vehicles at all times.
   3. No pipe cutting machine will be used on the inside floor slab.
   4. Steel will not be placed on interior slabs to avoid rust staining.

B. Maintain temperature of concrete above 50 degrees F. for seven days after placing. Protect work against frost, rapid drying and heavy rain.

PART 2 PRODUCTS

2.01 MEMBRANE CURING COMPOUND

A. Membrane Curing Compound: ASTM C 309 Type 1 - Clear or translucent, Class B. Moisture loss not more than 0.55 kg/sq. meter in 72 hours. VOC compliant.
   1. Dissipating resin type.
   2. Product shall be compatible with tilt-up bond breaker, floor sealers, and floor coverings.
   3. Product shall be easily removable from slab surface if film forming, and if used under building cover and not exposed to UV light.
   4. Acceptable Products:
      a. Dayton Superior: Clear Resin Cure J11W
      b. Euclid: Kurez DR-100
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DENSIFIER:

A. Penetrating, chemically reactive, concrete densifier containing lithium silicates equal to:
   1. Dayton Superior: Pentra-Hard Densifier.
   2. Nox-Crete: Duro-Nox LSC.
   3. Prosoco: Consolideck LS-CS
   4. SpecChem: LithSeal SC or Lite
   5. Substitutions: Not permitted.

2.03 CRACK REPAIR MATERIAL:

A. Two component, high penetration polyurethane for crack, and crack spall repairs.

B. Cracks Greater Than 30-MIL: (0.030 in.):
   1. Metzger McGuire: Rapid Refloor.
   2. Roadware, Inc.: Roadware 10 Minute Concrete Mender.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.04 SURFACE CAVITIES, VOIDS OR DENTS, SMALL SCRAPES, OBLONG SURFACE CAVITIES, AND ANCHOR BOLT REPAIRS

A. Acceptable Products:
   1. Metzger McGuire: Rapid Refloor
   2. Metzger McGuire: Rapid Refloor XP
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.05 SURFACE DELAMINATIONS REPAIRS

A. Acceptable Products:
   1. Metzger McGuire: Armor-Hard
   2. Metzger McGuire: Armor-Hard Extreme
   3. Metzger McGuire: Armor-Hard HDR
   4. Metzger McGuire: Armor-Hard LV
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.06 JOINT SPALL REPAIRS

A. Acceptable Products:
   1. Metzger McGuire: Armor-Hard
   2. Metzger McGuire: Armor-Hard Extreme
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.07 EVAPORATION RETARDANT:

A. Acceptable Products:
   1. Dayton Superior: AquaFilm.
   2. Euclid: Eucobar.
   3. Nox-Crete: Monofilm.
   4. BASF: Confilm.

5. SpecChem: Spec Film
6. Substitutions: Not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

3.02 SLAB FINISHES:

A. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

B. Using Laser Screed, consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners. Do not over-vibrate surface.

C. Bring slab surfaces to correct level with straightedge and strike-off. Use check rod, wide bull float or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

D. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Float surfaces on concrete in manner that will compact concrete and produce surface free of depressions or ridges. Test for grade or level and correct as necessary by removing excess or adding and compacting additional concrete. Surfaces to receive float finish include slabs to receive setting beds.

E. Trowel finish: Apply a 3 trowel finish to designated monolithic slab surfaces. After floating, begin first trowel finish operation using power-driven trowel. Begin final toweling when surface produces ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance. Do not overwork the final troweling operation. Do not burnish slab surfaces designed for robotic equipment operations such that gloss requirements are exceeded.

F. Non-slip broom finish: Immediately after trowel finishing, roughen concrete surface by brooming in direction perpendicular to main traffic routes. Coordinate required final finish with Owner's Representative before application. Apply non-slip broom finish to all exterior concrete platforms, steps, pavement and ramps.

3.03 EVAPORATIVE RETARDANT:

A. When concrete slab placement is subject to high evaporation rates due to high temperatures, wind and/or low humidity, the Contractor shall use the evaporation retardant to minimize plastic cracking. The retardant may be required to be applied one or more times during the finishing operation and always immediately after a finishing step. The initial application is usually made after the strike-off operation.

3.04 CONSTRUCTION JOINTS:

A. Locate construction joints as indicated on the drawings or as approved.

B. Provide 1/8 inch edger to edge of second slab placement so that joint can be easily located and recut for joint filling operation. Do not edge first placement.

3.05 CONTRACTION JOINTS:

A. Locate contraction joints as indicated on the drawings.

B. All sawn contraction joints shall be made using the "Soff-Cut" method with operating vacuum attached to saw. Initial depth of joint with new blade shall be one-fifth slab depth +/- 1/4 inch. Saw joints as soon as concrete has hardened sufficiently to prevent raveling or dislodging of aggregates. Replace saw blades at first sign of raveling at the joint. Skid plate shall be replaced each time a saw blade is replaced. Use "joint saver" inserts, provided by the saw manufacturer, at all intersecting joints and at location where front wheel crosses perpendicular to the previously cut joint.

3.06 DENSIFIER

A. The densifier shall be applied immediately after the concrete surface has hardened sufficiently so that it will not be marred by the application process, and prior to the curing compound application.

B. Application: Follow the manufacturer's written instructions for the application of the densifier.
   1. The manufacturer’s technical representative shall be present at the initial application to observe the work and provide technical assistance.
   2. It is critical that the dust or slurry from saw cutting of floor joints be thoroughly removed from the slab prior to application or alternatively, the densifier may be applied prior to saw cutting.

3.07 CURING:

A. Cure floor surfaces in accordance with ACI 308.1.

B. Membrane Curing Compound:
   1. The compound shall be applied uniformly over the entire surface in accordance with manufacturer's instruction.
   2. Moisture loss from absorption of forms shall be minimized by keeping forms wet until they can be safely removed.
   3. During 7 day curing period, the surfaces shall be protected from damage by equipment, temperature change, stored materials, curing procedures, rain and running water.

3.08 GRINDING OF CONSTRUCTION JOINTS

A. All construction joints shall be ground and polished to a level, even, smooth, slick finish using gasoline powered diamond-disk and/or stone grinders. The final polishing pass shall be performed using not less than 100 grit stone or diamonds.

3.09 SLAB SURFACE ROUGHNESS REMEDIATION REQUIREMENTS

A. Where minimum roughness (Ra) is not to be less than 2.54 µm (100 µin), slab surface remediation will be required. Submit remediation procedures for approval. When remediating Station Queues and Highways areas, remediation shall extend at least 6 foot - 6 inches outside of the Station Queues and Highways and 6 foot - 6 inches into the Storage Cells.

3.10 PROTECTION:

A. Where other concrete structures are to be poured on top of or adjacent to finished surfaces, take all necessary precautions to prevent damage from erection of formwork or staining from concrete laitance.

B. Alert other trades to the need for special protection against rolling or sliding heavy loads across the surface, oil drippings from pipe threaders, spillage of paint, plaster, mortar, or any other item that may damage the surface. Insure that the covering is not damaged or removed during the progress of the work.

C. Review proposed tilt panel construction and erection procedures to ensure that scratching, marring, gouging, and cracking of the floor slabs will be avoided.

D. If the floor slab is used as a casting area for tilt-wall construction, all reveals and forms shall be glued to the slab. No anchors or holes shall be drilled into the slab for these purposes.

E. All holes in slab required for temporary bracing must be pre-drilled to install concrete screw anchors in order to avoid spalling of the concrete. When completed, unscrew anchors and patch hole with rigid repair material.

3.11 DEFECTIVE FLOOR SLAB:

A. If it is determined that any type of crack or defect in the slab-on-ground has occurred due to the result of Contractor's failure to comply with these specifications and construction documents, Contractor shall repair and/or replace cracked and defective concrete to the satisfaction of the Owner, and as directed by the Owner’s representative at no cost to Owner or increase in project completion time..

3.12 REPAIR OF FLOOR SLABS:

A. General:
   1. Repairs are to meet as a minimum the requirements set out in this specification. Repair materials and procedures are to be submitted for approval.
   2. Do an initial repair of each type of repair and obtain the Owner's Representative approval before doing other repairs.
   3. Repairs made after the Tenant moves in shall be made at times that do not interfere with regular Tenant activities.

B. Crack Repairs:
   1. Repair those cracks that meet any of the following conditions:
      a. The crack is wider than or equal to 0.030 inch. Cracks less than 0.030 inch do not need repairs.
      b. The crack edges have begun to spall or the crack has begun to form "islands", even though the crack width is less than 0.030 inch.
      c. Adjacent slab elements (on either side of the crack) exhibit vertical movement when crossed by a loaded lift truck.
   2. Method of Repair:
      a. Multiple cracks clustered in a spider web appearance:
         1) Remove concrete slab forming a rectangular area normal to column grid. Extend rectangular area to the nearest contraction or construction joint.
         2) Place and finish new concrete with same specifications as original slab. All edges shall be drilled and grouted into existing slab using 3/4 inch square x 12 inch long smooth steel dowels with PNA square dowel clips at 18 inch on-center. Dowels shall be placed centered in slab, with half the dowel drilled and placed into existing slab. Bond breaker is to be placed on vertical face of existing slab immediately prior to placing the concrete.
      b. All other isolated cracks:
         1) Crack Spalls and Deflections: Remove all loose materials back to sound concrete with a chisel or light chipper. Use a wire brush or twisted wire wheel to clean the repair area.
         2) Surface Cracks: Clean out the crack with compressed air, high pressure water blast or wire brush.
         3) All surfaces must be free of dirt, oils, dust, laitance, old repair materials or any other material detrimental to the repair material bonding to the existing concrete.
         4) In accordance with manufacturer's recommendations, fill the crack at all locations.
         5) If permitted by the repair product manufacturer, clean, fine sand may be used both to extend the product and to prevent bottom leakage in the wider cracks.
         6) Multiple injections passes may be required to ensure that the crack filler is left higher than the adjacent concrete at all locations.
         7) After the filler has hardened, grind/polish the joint flush with the surrounding surface, providing a smooth and seamless repair.
      c. Surface cavities, voids or dents, small scrapes, oblong surface cavities, anchor bolt, surface delaminations and joint spall
         1) See drawings for repair procedures.

         Notes to specifier: The drawing SR-100 Typical Slab Repair Details is to be included as part of the structural drawings.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs.

END OF SECTION

SECTION 03 3565
INTERIOR CONCRETE POLISHING (NO DYE)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Grinding of the slab surface to receive clear reactive, penetrating liquid densifier.
   2. Progressively polishing and burnishing of the slab surface to achieve Finish Requirements.

B. Related Sections:
   1. Section 01 3000 - Administrative Requirements: Pre-Slab Meeting
   2. Section 01 4540 - Concrete Testing - Random Traffic Areas Floor Flatness and Levelness Testing (Ff - Fl)
   3. Section 03 3000 - Cast-in-Place Concrete
   4. Section 03 3560 - Concrete Floor Finishing
   5. Section 07 9216 - Interior Floor Joint Filler and Sealant

1.02 REFERENCES

A. A. Referenced standards are to be the latest editions adopted at project bid date.
   1. Living Building Challenge (LBC) 2.0/2.1.
   2. Scientific Certification System (SCS) Indoor Air Quality Gold Certification.
   3. NSF International/Nonfood Compound Registration.
   4. American National Standard Institute / National Floor Safety Institute ANSI/NSFI B101.1-2009 Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.
   5. American Society for Testing and Materials:
      a. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
      b. ASTM C1353 - Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser
      c. ASTM D523- Standard Test Method for Specular Gloss (60°).
      d. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
      e. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
      f. ASTM E96/96M Method B (Water Method) - Standard Test Methods for Water Vapor Transmission of Materials.
      g. ASTM G154 -Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

1.03 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's product data sheets on all products to be used for the work.
      a. All Specified Concrete Surface Treatments.

B. VOC Certification: Submit certification that products furnished comply with regulations controlling use of volatile organic compounds (VOC).

C. Applicator to submit a minimum of 5 projects completed within the last year of similar scope and complexity. Include project contact information for each if requested.

D. Letter of completion from chemical manufacturer stating that installer is listed applicator of special concrete finishes, and has completed the necessary training programs at time of Bid and within submittal package.

E. Test Reports
   1. Provide test reports confirming compliance with specified performance criteria.

1.04 QUALITY ASSURANCE

A. Gloss Requirements:
   1. General:
      a. Gloss shall be considered as a quantitative value that expresses the degree of reflection when light hits the concrete floor surface.
      b. Perform sweeping, scrubbing and high speed burnishing to achieve and maintain gloss requirements until Tenant's possession.
         1) Test polished floor slab for gloss as follows:
            (a) Record measurement locations and value on copy of the floor plan.
            (b) Collect a minimum of three (3) random measurements per sample area.
            (c) Sample areas to be bounded by column lines.
            (d) Ensure the Specified Overall Gloss Value (SOGV) = 40 at 60-degrees and Minimum Local Gloss Value (MLGV) = 25 at 60-degrees
            (e) The SOGV is determined by the average of all measurements for a sample area.
            (f) No single measurement in a sample area is to be less than the MLGV.
            (g) If the SOGV for a sample area is less than specified and no single value was below the MLGV, collect an additional 3 measurements at evenly distributed random locations and recalculate the SOGV using all measured values.
            (h) Perform one follow-up test for each sample area that does not meet the gloss requirements after contractor performs corrections.
         2) Remedies for Out-of-Tolerance Work: Remedy floor area as required by Owner Representative

B. Penetrating Concrete Densifier and Surface Protectant Treatment Installer Qualifications:
   1. Provide letter of completion from chemical manufacturer stating that installer is listed applicator of special concrete finishes, and has completed the necessary training programs at time of Bid and within submittal package.
   2. Applicator shall be familiar with the specified requirements and the methods needed for proper performance of work of this section. Applicator must have availability of proper equipment to perform work within scope of this project on a timely basis. Applicator must have a minimum of 5 projects completed within the last year of similar scope and complexity.

C. Pre-Installation Meeting: Shall convene before the start of work on new concrete slabs, patching and repairing of existing concrete slabs and start of application of concrete finish system.
   1. Require attendance of parties directly affecting work of this Section, including the Owner's Representative, Contractor, Architect, concrete installer, and applicator. Meeting should only convene when all parties are present.
   2. Review the following:
      a. Physical requirements of completed concrete slab and slab finish.
      b. Locations and time of test areas.
      c. Protection of surfaces not scheduled for finish application.
      d. Surface preparation.
      e. Application procedure.
      f. Quality control.
      g. Cleaning.
      h. Protection of finish system.
      i. Coordination with other work.
      j. Testing requirements

D. Mock-up shall take place on site, prior to the start of the polished concrete finishing process.
   1. Require attendance of parties directly affecting work of this Section, including the Contractor, Architect, applicator, and Owner's Representative.

2. Contractor to notify the above parties one week in advance of date and time when mock-up will be completed.
3. Demonstrate the materials, equipment and application methods to be used for work specified herein in pre-approved location approximately 50 sq. ft. in area or as directed by Architect or Owner's Representative.
4. Retain acceptable mock-up during construction as a standard for judging the completed work. Areas may remain as part of the completed work.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.

B. Store concrete hardener/densifier and surface protectant treatment in environment recommended on published manufacturer's product data sheets.
   1. Store containers upright in a cool, dry, well-ventilated place, out of the sun with temperature between 40 and 100 degrees F (4 and 38 degrees C).
   2. Protect from freezing.
   3. Store away from all other chemicals and potential sources of contamination.
   4. Keep lights, fire, sparks and heat away from containers.
   5. Do not drop containers or slide across sharp objects.
   6. Do not stack pallets more than three high.
   7. Keep containers tightly closed when not in use.

1.06 PROJECT CONDITIONS

A. Environmental limitations:
   1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance and finishing requirements.

B. Close areas to traffic during floor application and after application for time period recommended in writing by manufacturer.

C. The completed slab shall be protected to prevent damage by the other trades during floor completion.

D. Temperature Limitations:
   1. Do not apply when surface and air temperature are below 40 degrees F (4 degrees C) or above 95 degrees F (35 degrees C) unless otherwise indicated by manufacturer's written instructions.
   2. Do not apply when surface and air temperatures are not expected to remain above 40 degrees F (4 degrees C) for a minimum of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.

E. Do not apply under windy conditions such that the concrete surface treatment may be blown to surfaces not intended.

F. Do not apply to frozen substrate. Allow adequate time for substrate to thaw if freezing conditions exist before application.

G. Do not apply earlier than 24 hours after rain or if rain is predicted for a period of 8 hours after application, unless otherwise indicated by manufacturer's written instructions.

H. Temporary Heat: Ambient temperature of 50 degrees F (10 degrees C) minimum.

I. Ventilation: Provide adequate ventilation in confined or enclosed areas in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GLOSS MEASUREMENTS

A. Taken independent of ambient lighting and to be taken within a sealed measurement window located beneath the test unit.

B. Approved Equipment:
   1. Elcometer 480 Triple-Angle Glossmeter
   2. MIZA Trigloss 20°/60°/85°
   3. Rhopoint IQ 20/60/85
   4. Novo-Gloss Trigloss 20/60/85
   5. Novo-Gloss Trio 20/60/85

2.02 MATERIALS

A. Basis of design is based upon Prosoco products. Other acceptable manufacturers are:
   1. Dayton Superior - Pentra-Hard.
   2. Nox-Crete - Duro-Nox LS.
   3. SpecChem - LithSeal.

B. Pre-Densifier Concrete Cleaner: Shall remove dirt, oil, grease, and other stains from existing slab surface.
   1. Equal to Consolideck Cleaner/Degreaser manufactured by PROSOCO, Inc.
   2. Auto Scrubber Machine: equipment used for cleaning operations, as required to produce specified results.

C. Penetrating Concrete Densifier: Lithium silicate hardener/densifier shall penetrate and react with concrete to produce insoluble calcium silicate hydrate within the concrete pores. The penetrating concrete hardener shall reduce dusting, increase abrasion resistance and not contribute to surface crazing/surface Alkali Silicate Reactions (ASR).
   1. Equal to Consolideck LS-CS, manufactured by PROSOCO, Inc.
   2. Subject to compliance with the following requirements:
      a. Comply with national, state and district AIM VOC regulations and be 50 g/L or less.
      b. Registered as an approved NSF International/Nonfood Compound Registration.
      c. Abrasion Resistance: >50% improvement over untreated samples when tested in accordance with ASTM C1353.
      d. Achieve ‘High Traction Range’ readings when tested in accordance with ANSI B101.1.
      e. Coefficient of Friction: >0.60 dry, >0.60 wet when tested in accordance with ASTM C1028.
      f. Adhesion: >10% increase in pull-off strength when compared to an untreated sample when tested in accordance with ASTM D4541.
      g. Water Vapor Transmission: 100% retained when compared to untreated samples when tested in accordance with ASTM E96/96M Method B (Water Method).
      h. UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

D. Interior Concrete Protective Treatments:
   1. General Purpose high-gloss film forming premium sealer shall contain lithium silicate hardener/densifier to improve the surface sheen, and surface hardness.
      a. Equal to Consolideck LSGuard, manufactured by PROSOCO, Inc.
      b. Subject to compliance with the following requirements:
         1) Comply with national, state and district AIM VOC regulations.
         2) Registered as an approved NSF International/Nonfood Compound Registration.
         3) Achieve ‘High Traction Range’ readings when tested in accordance with ANSI B101.1.
         4) Coefficient of Friction: >0.60 dry, >0.60 wet when tested in accordance with ASTM C1028.
         5) Adhesion: : >10% increase in pull-off strength when compared to an untreated sample when tested in accordance with ASTM D4541.
         6) UV Stability: No degradation or yellowing of material when tested in accordance with ASTM G154.

2.03 EQUIPMENT

A. Auto Scrubber Machine: equipment used for cleaning operations, as required to produce specified results.

B. Hand Grinder or stand-up edger for edge grinding/polishing.

C. Polishing Equipment:
   1. Polishing machines shall be in full operating condition during the duration of the work to achieve specified Finishing Requirements.
   2. Dry grinding/polishing machines must include a dust extraction system, including HEPA filtration vacuum.

D. Diamond Segments:
   1. Use heads from the same manufacturers throughout the entirety of the project.

E. Diamond Heads Types:
   1. Metal Diamonds: 80 or 150.
   2. Hybrid Style Diamonds: 50 or 100.
   3. Resin Bonded, Phenolic Diamonds: 100, 200, 400, 800, 1500, and 3000 (if necessary).

F. Burnishing Machine and Burnishing Pads shall be used to produce specified results.
   1. Burnishing Machine: High speed burnisher, generating pad speeds of 1,500 RPM or higher, as recommended by protective treatment manufacturer. Dust skirt must be installed at time of work.
   2. Burnishing Pads: as recommended by protective treatment manufacturer.
      a. White Burnishing Pad, non-abrasive
      b. Consolideck Heat Pad manufactured by PROSOCO, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate with installer present for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Surfaces that are in question or that will affect the execution or quality of work must be brought to the attention of the Owner’s Representative before work may begin.

3.02 PREPARATION

A. Clean dirt, dust, oil, grease and other contaminants that interfere with penetration or performance of specified product from surfaces. Use appropriate concrete cleaners approved by the concrete surface treatment manufacturer where necessary. Rinse thoroughly using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of product.

B. Repair, patch and fill cracks, voids, defects and damaged areas in surface as approved by the Owner's Representative. Allow repair materials to cure completely before application of product.

C. Variations in substrate texture and color will affect final appearance and should be corrected prior to application of sealer/hardener system and the polishing steps.

D. Protect surrounding areas prior to application. If product is accidentally misapplied to adjacent surfaces, flush with water immediately before material dries.

E. Avoid contact in areas not to be treated. Avoid contact with metal, glass and painted surfaces.

F. Seal open joints in accordance with Section 07 9000 - Joint Sealants.

G. Apply specified joint filler, sealants and caulking and allow complete curing before application of Penetrating Concrete Hardener/Densifier.

H. Do not proceed until unsatisfactory conditions have been corrected.

3.03 GENERAL REQUIREMENTS

A. Dry and wet grinding/polishing is acceptable when industry standard polishing procedures are adhered to.

B. Between and after final polishing passes, thoroughly scrub and rinse slab surface with clean water and vacuum with auto-scrubber.

C. Sequential progression of diamond polishing steps shall be required and limited to no more than double the grit value of the previous diamonds used.

D. Overlap adjacent polishing passes by 25%.

E. Perform each pass perpendicular to the other pass north/south then east/west; multiple passes may be needed.

F. Include all work necessary to achieve specified Finish Requirements.

3.04 INTERIOR CONCRETE POLISHING

A. Factory Trained Applicator to provide grit starting level and all other aspects that will contribute to the specified gloss in the specifications.

B. Progressively grind and polish the slab surface utilizing approved diamond segments as necessary to produce Finishing Requirements while meeting the general requirements.

3.05 APPLICATION OF PENETRATING CONCRETE DENSIFIER

A. Where slab surfaces have not been treated with initial application of penetrating concrete hardener/ densifier, apply in accordance with manufacturer written instructions.

B. Apply hardener/densifier at the rate of 500-700 square feet per gallon with a low pressure sprayer fitted with a 0.5 gpm spray tip. (Typically after 200-grit and no later than 400 grit)

C. Apply sufficient material to keep concrete surface wet for 5-10 minute period, without producing puddles.

D. Allow treated surface to dry.

E. Continue progressively polishing floor with required resin diamonds as necessary to produce desired final finish.

3.06 APPLICATION OF INTERIOR CONCRETE PROTECTIVE TREATMENT

A. Application of general purpose, high gloss protective treatment (LSGuard):
   1. Apply per manufacturer's published recommendations to clean, dry slab at the completion of mechanically polishing the slab surface.
   2. Lightly wet a clean microfiber pad with LSGuard and wring out excess, leaving the pad damp.
   3. Working from one joint to another, apply a light, fine spray of LSGuard protective treatment to a small section of the floor using a clean, pump-up sprayer fitted with a 0.5 gpm spray tip , at an estimated coverage rate of 2000-3000 square feet per gallon.
   4. Using the damp microfiber pad and firm downward pressure, immediately spread the protective treatment to produce a thin, even coating. Spread the product as far as possible while maintaining a wet edge. Properly applied, protective treatment dries quickly. Stop spreading once drying begins. Avoid overlapping.
   5. Allow to dry tack free, typically 20-60 minutes.
   6. Once dry, high- speed burnish slab surface fitted with Consolideck Heat pad to increase gloss and to help the treatment fuse and bond with the concrete for increased durability and longevity. Surface temperatures immediately behind the burnisher must achieve 90.5°F. (Burnish between coats if multiple applications are desired.)
   7. Repeat above steps 1-6, as necessary for additional applications of LSGuard, to achieve desired final finish (Maximum 3 coats).

3.07 SLAB PROTECTION

A. Protect finished floors to prevent damage including staining, gouges and scratching by construction traffic and activities until possession.

B. Do not drag or drop equipment or material across the slab which will scratch or chip it.

C. Tires shall be inspected for debris prior to use on slab. Remove embedded items which may cause damage to floor slab.

D. Clean up spills on slab immediately. Provide cleaning chemicals and absorptive materials.

E. Develop a concrete protection procedure which addresses the following procedures:
   1. Communication of protection plan to subcontractors and vendors.
   2. Procedures for cleaning up slab spills, including use of and availability of cleaning chemicals and absorptive materials at Site.

F. Provide a clean slab surface at all times, in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 03 4100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall panels with integral insulation.

B. Insulated concrete wall panels.

C. Grout packing.

D. Connection and supporting devices.

1.02 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

D. ASTM A416/A416M - Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

G. ASTM C150/C150M - Standard Specification for Portland Cement.

H. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

I. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel.

K. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel.

L. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.

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

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

1.03 DESIGN REQUIREMENTS

A. Conform to ACI 318 and applicable code for design load and construction requirements applicable to work of this section.

B. Engage a fabricator who assumes undivided responsibility for engineering structural precast concrete units by employing a qualified professional engineer, registered in the state where the project is located, to prepare design calculations, fire-resistance calculations, shop drawings, and other structural data.

C. Engineer and fabricate jambs of precast panels to withstand wind loads developed on glazed aluminum window assemblies and transferred to panels as shown on drawings, inclusive of horizontal curtain wall assemblies and associated point loads.

D. Engineer structural precast concrete units to withstand design loadings indicated on the drawings within limits and under conditions required. Members shall withstand own weight, design loads due to pressure and suction of wind, seismic forces, and live and dead loads. Design for erection forces and wind forces during construction under temporary construction bracing. Design temporary bracing, deadmen or soil anchors, and associated connections.

1. Calculate structural properties of framing members in accordance with ACI 318.

E. Design members exposed to the weather to provide for movement of components without damage, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to seasonal or cyclic day/night temperature ranges.

F. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

G. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval if required by permitting process.

H. While temporarily braced during construction, precast members and temporary bracing (including concrete deadmen or soil anchors) shall withstand a construction period design wind force equal to the larger of 15 psf and the calculated temporary wind load in accordance with ASCE 37 “Design Loads on Structures During Construction”.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.

C. Indicate locations and details of temporary bracing and supports including: construction period design wind speed; total brace force per panel; brace type, locations, and number of braces required; deadman or soil anchor type, size, location, and number required; connections to deadman, slab on grade, or soil anchor;and post-installed anchor type and torque required.

D. Shop drawings shall be signed and sealed by the fabricator's responsible, qualified Professional Engineer licensed in the State in which the Project is located.

E. Integrally Insulated Panel System Design Data:
   1. Thermal Resistance: Submit calculations complying with ASHRAE Std 90.1 I-P, isothermal planes method, and demonstrating thermal resistance of integrally insulated panel system.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with requirements of PCI MNL-116, PCI MNL-120, PCI MNL-123, and PCI MNL-135.

B. Fabricator Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of experience. The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) plant Certification program, the National Precast Concrete Association (NPCA) plant certification program, or other qualified third party certification prior to start of fabrication of this project.

C. Erector Qualifications: Company specializing in erecting products of this section with not less than 5 years experience.

D. Design precast concrete members under direct supervision of a Professional Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

E. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1/D1.1M and AWS D1.4/D1.4M.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast concrete units to site in such quantities and at such times to ensure continuity of erection.

B. Handle precast members in position consistent with their shape and design. Lift and support only from support points.

C. Protect members to prevent staining, chipping, or spalling of concrete.

D. Mark each member with date of production and final position in structure.

1.07 PROJECT CONDITIONS

A. Coordinate the work of framing components not pre-tensioned but associated with the work of this section.

PART 2 PRODUCTS

2.01 PRECAST UNITS

A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.

2.02 MATERIALS

A. Cement: Gray Portland type, conforming to ASTM C150/C150M, Type I.

B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.03 REINFORCEMENT

A. Tensioning Steel Tendons: ASTM A416/A416M, Grade 250 or 270; seven-wire stranded steel cable; low-relaxation type; full length without splices; uncoated.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi.
   1. Deformed billet-steel bars.
   2. Unfinished.

C. Steel Welded Wire Reinforcement: ASTM A1064/A1064M plain type or deformed type; in flat sheets; unfinished.

2.04 INTEGRALLY INSULATED PANEL SYSTEM (PIN CONNECTORS)

A. Integrally Insulated Panel System: Precast concrete panel formed from two layers of concrete with continuous rigid insulation and non-conducting pin connectors between layers.
   1. Connectors: System manufacturer's standard; corrosion- and alkali-resistant, glass fiber reinforced, vinyl composite pultrusions with integral limiting flanges, serrated profile and thermoplastic sealing collar; comply with ICC-ES AC320.
   2. Continuous Insulation: Rigid extruded polystyrene (XPS) insulation board, ASTM C578, Type IV; factory fabricated with holes or slots for connectors at manufacturer-designated size and spacing.
   3. Design and construct panels to maintain overall u-value of 0.05 (R=20), with less than one percent change due to penetrations and connections, when calculated in accordance with ASHRAE 90.1, isothermal planes method.

2.05 ACCESSORIES

A. Connecting and Supporting Devices; Anchors and Inserts: Plates, angles, items cast into concrete, and inserts conforming to PCI MNL-123, and as follows:
   1. Material: Carbon steel conforming to ASTM A36/A36M.
   2. Finish:
      a. Prime painted except where indicated otherwise.
      b. Hot-dip galvanized in accordance with ASTM A153 for all devices below steel joist and above floor slab, and exterior locations.

B. Grout:
   1. Non-shrink, non-metallic, minimum yield strength of 4,000 psi at 28 days.

C. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, or Neoprene (Chloroprene); 1/8 inch thick, smooth both sides.

D. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.

E. Prime Paint: Zinc rich alkyd type.

F. Patterned Formliner: Fitzgerald Formliners; Pattern 16021 - "1.5" Wide Plank, Random Depth". Locations and layout as indicated on drawings.

2.06 FABRICATION

A. Conform to fabrication procedures specified in PCI MNL-116.

B. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

C. Tension reinforcement tendons as required to achieve design load criteria.

D. Provide required openings with a dimension larger than 10 inches and embed accessories provided under other sections of the specifications, at indicated locations.

E. Exposed Ends at exposed insulation: Fill recess with non-shrink grout, trowel flush.

F. Integrally Insulated Panel System: Comply with manufacturer's written installation instructions.

2.07 FINISHES

A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.

B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

C. All defects, which are exposed to view, shall be corrected before final finish.

D. Finish members to PCI MNL-116 Finish B grade.
   1. All air holes over 1/4 inch should be filled, as well as smaller holes that occur in concentrations. Discoloration allowed at form joints; form joints ground smooth.
   2. Exterior surfaces not cast on form liners shall have a smooth finish with all fins removed.
   3. Interior surfaces exposed to view shall have smooth screed finish.
   4. Interior surfaces not exposed to view shall have a float finish.

2.08 FABRICATION TOLERANCES

A. Conform to fabrication tolerances specified in PCI MNL-116 , except as specifically amended below:
   1. Location of Architectural Features: Plus or minus 1/4 inch.
   2. Height of Opening: Plus or minus 1/2 inch.
   3. Location of Opening: Plus or minus 1/4inch
   4. Location of Inserts for Structural Connectioons: Plus or Minus 1/8 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that site conditions are ready to receive work and field measurements are as shown on shop drawings.

B. Site Access: General contractor shall be responsible for providing suitable access to the building, proper drainage and firm, level bearing for the hauling and erection equipment to operate under their own power.

3.02 PREPARATION

A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.03 ERECTION

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.

B. Align and maintain uniform horizontal and vertical joints, as erection progresses.

C. Temporarily brace and support panels securely in position according to the temporary bracing design prepared by the lifting insert and panel bracing manufacturer/engineer. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to panels are secured, and when permitted by the Professional Engineer of Record. Use of manufacturer specified or approved brace anchors at

all bracing points shall be required. Wedge anchors or expansion bolts by others is not acceptable.

1. All slab anchors shall be torqued to the required specification and certified by the installing contractor. All slab anchors must be re-torqued and re-certified following exposure to winds in excess of 35 mph.

D. Adjust differential camber between precast members to tolerance before final attachment.

E. Install bearing pads.

F. Set vertical units dry, without grout, attaining joint dimension with lead or plastic spacers.

G. Grout space between bottom of panel and top of footing.

H. Secure units in place. Perform welding in accordance with AWS D1.1/D1.1M.

I. Protect members from staining.

J. Holes caused by installation of temporary braces anchored to floor slabs shall be patched with structural polymer adhesive, flush and smooth with floor surface. Color shall closely match concrete color. Provide mockup of patch for Architect approval prior to beginning work.

K. Patch panels with plastic inserts where lifting hooks or other devices have been removed.

3.04 TOLERANCES

A. Erect members level and plumb within allowable tolerances.

B. Conform to PCI MNL-135 for erection tolerances.

1. Maximum Jog in Alignment of Matching Ends: Plus or minus 1/4 inch.
2. Joint Taper of Height: Plus or minus 1/2 inch.

C. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect. Execute modifications as directed.

3.05 PROTECTION

A. Protect members from damage caused by field welding or erection operations.

3.06 CLEANING

A. Clean weld marks, dirt, or blemishes from surface of exposed members.

END OF SECTION

SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Base plates, shear stud connectors and expansion joint plates.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection.

B. Section 05 2100 - Steel Joist Framing.

C. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

D. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

A. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges.

B. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

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

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

F. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

G. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).

H. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

I. ASTM A490M - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).

J. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

K. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

L. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric).

M. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

N. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

O. 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.

P. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

Q. ASTM F436 - Standard Specification for Hardened Steel Washers.

R. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

S. AWS D1.1/D1.1M - Structural Welding Code - Steel.

T. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Indicate cambers and loads.
   3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

E. Delegated connection design submittal: For structural steel connections indicated to comply with design loads, include the following documents signed and sealed by the qualified professional engineer registered in the state the project is located in and responsible for their preparation:
   1. Comprehensive analysis data.
   2. Letter stating connections deytailed in shop are in conformance with delegated connection engineer's design.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store structural steel members at project site above ground on platforms or skids. Do not place in contact with earth or concrete slabs. Store bolts and welding rods in original containers with labels intact.

B. Protect items from corrosion affecting structural strength and use.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles, Plates, and Channels: ASTM A36/A36M.

B. Steel W Shapes and Tees: ASTM A992/A992M, ASTM A910 (where indicated on structural drawings)

C. High-Strength Steel Plates: ASTM A572/A572M

D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.

E. Pipe: ASTM A53/A53M, Grade B, Finish black.

F. Shear Stud Connectors: Made from ASTM A 108 Grade 1015 or 1020 bars, Type B, cold finished carbon steel, with dimensions complying with AISC Specifications.

G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, Grade A325-N with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

H. Unfinished Bolts and Nuts: ASTM A 307, Grade A, regular low-carbon steel bolts and nuts.

I. High-Strength Structural Bolts: ASTM A490 or ASTM A490M; Type 1 alloy steel, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436 washers.

J. Anchor Bolts: ASTM F1554, Grade 36 unless otherwise indicated.

K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

L. Shop and Touch-Up Primer: SSPC-Paint 15, Type 1, light gray oxide, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.
   1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Develop required camber for members.

C. Connections: Weld or bolt shop connections as indicated.
   1. Bolt field connections, except where welded connections or other connections are indicated.
   2. Provide high-strength threaded fasteners for principal bolted connections, except where unfinished bolts are indicated.
   3. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection, unless otherwise noted on drawings.

D. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts". Bolts shall be installed with hardened washers under the element turned in tightening bolts to facilitate verification inspection

E. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

F. Assemble and weld built-up sections by methods which will produce true alignment of axis without warp.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Shop weld shear connectors, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
   1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates. Remove burrs resulting from drilling operations.

I. Header Units: Provide header units to support tail joists at openings in floor or roof system unless otherwise indicated.

2.03 FINISH

A. Surface Preparation:
   1. Clean all surfaces after fabrication and immediately prior to shop painting in accord with SSPC-SP2, Hand Tool Cleaning, SSPC- SP3, Power Tool Cleaning, or SSPC-SP6, Commercial Blast Cleaning at manufacturer's option.
   2. Blast clean only when relative humidity is below 85% and when surface temperature of steel is a minimum of 5 degrees F. above the dew point. Remove all traces of blast residue and dust. Do not contaminate the surfaces. Require workmen to wear clean gloves when handling blast cleaned steel.

B. Shop Painting:
   1. Apply specified shop coat in accord with manufacturer's product data to provide a minimum dry film thickness of 2.0 mils. Apply shop coat of paint within four hours after cleaning and before rust-bloom occurs. Paint only in relative humidity below 85% and surface temperatures of 5 degrees F. above dew point.
   2. Apply at dry film thickness of 0.5 mils.

C. Shop Painting Schedule: Paint all structural steel with a shop coat of paint, except:
   1. Members encased in concrete.
   2. Contact surfaces of welded connections and areas within 2" of field welds except as noted.

3. Contact surfaces of high-strength bolted connections.
4. Surfaces receiving sprayed-on fireproofing.
5. Surfaces receiving field welded steel studs.

PART 3 EXECUTION

3.01 ERECTION

A. Erect structural steel in compliance with AISC S303 "Code of Standard Practice for Steel Buildings and Bridges".

B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure within specified AISC tolerances.
   2. Splice members only where indicated and accepted on shop drawings.
   3. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes that must be enlarged to admit bolts.
   4. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing unless acceptable to Architect/ Engineer. Finish gas-cut sections equal to a sheared appearance when permitted.

D. Do not field cut or alter structural members without approval of Architect.

3.02 TOUCH-UP PAINTING

A. After erection, clean and remove rust, dirt and other foreign matter from exposed surfaces of field connections, unpainted areas adjacent to field connections, and damaged areas in shop primer. Touch-up paint with primer to the same standards as required for the shop coat and paint using identical primer.

3.03 TOLERANCES

A. Level and plumb individual members of structure within specified AISC tolerances.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing 100 percent of bolts at each connection.
   1. Load indicating washers or snap off bolts shall be 100 percent visually inspected.

C. Welded Connections: Visually inspect all field-welded connections.

D. Re-inspection shall be required for all failed tests.

END OF SECTION

SECTION 05 2100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Open web steel joists and joist girders , with bridging, attached seats and anchors.

1.02 RELATED REQUIREMENTS

A. Section 01 4000 - Quality Requirements: Testing and inspection.

B. Section 05 1200 - Structural Steel Framing: Superstructure framing.

C. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches in decking.

D. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

C. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel.

F. SJI (SPEC) - Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders.

G. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders.

H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

I. SSPC-SP 2 - Hand Tool Cleaning.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

D. Calculations: Document design calculations supporting submitted assemblies.

1.05 QUALITY ASSURANCE

A. Design special joists and joist girders (non-uniform, unequal, or special loading not applicable to standard SJI load tables), and connections not detailed on drawings 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.

B. Provide joists fabricated in compliance with the following, and as herein specified.
   1. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, K Series"
   2. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, LH Series"
   3. Steel Joist Institute (SJI) "Standard Specifications for Open Web Steel Joists, DLH Series"
   4. Steel Joist Institute (SJI) "Standard Specifications for Joist Girders"

C. Inspect joists and joist girders in accordance with applicable SJI specifications.

D. Perform Work, including that for headers and other supplementary framing, in accordance with SJI (SPEC) Standard Specifications Load Tables and SJI Technical Digest No. 9.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements. Handle and store joists in a manner to avoid deforming members and to avoid excessive stresses.

B. Store steel joists at project site above ground on platforms or skids. Do not place in contact with earth or concrete slabs.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with applicable SJI Specifications.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular hexagon type, low carbon steel.

C. High-Strength Threaded Fasteners: ASTM A325 or A490 heavy hexagon structural bolts with nuts and hardened washers.

D. Steel Prime Paint: Paint shall be manufacturers standard light grey primer conforming to SJI "Standard Specifications", for the shop painting of steel joists

E. Anchor Bolts, Nuts and Washers: ASTM A307, hot-dip galvanized per ASTM A153/A153M, Class C.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, Type 1, light gray oxide, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. General: Fabricate steel joists and joist girders in accordance with applicable SJI Specifications.

B. Extended Ends: Provide extended ends on joists where shown, complying with manufacturer's standards and requirements of applicable SJI Specifications.

C. Bridging: Provide horizontal or diagonal type bridging for joists, complying with applicable SJI Specifications.
   1. Provide bridging anchors for ends of bridging lines terminating at walls or beams.
   2. Coordinate location of bridging with ESFR sprinkler heads to avoid obstruction conflicts.

D. Header Units: Header units to support tail joists at openings in floor and roof systems shall be provided in Section 05 1200 unless otherwise indicated.

2.03 FINISH

A. Shop prime joists as specified.

B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

C. Apply one shop coat of steel prime paint to joists, joist girders, and accessories by spray, dipping, or other methods to provide a continuous dry paint film thickness of not less than 1.0 mil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 ERECTION

A. Erect joists with correct bearing on supports.

B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.

C. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.

D. Coordinate placement of anchors in concrete construction for securing bearing plates and angles.

E. Position and field weld joist chord extensions and wall attachments as detailed.

F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.

G. Do not field cut or alter structural members without approval of joist manufacturer.

H. After erection, clean and remove rust, dirt an dother foreign matter from exposed surfaces including field connections. Prime welds, damaged shop primer, and surfaces not shop primed . Use same type of paints as used for shop painting.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", testing 100 percent of all bolts.

C. Welded Connections: Visually inspect all field-welded connections.

D. Re-inspection shall be required for all failed tests.

END OF SECTION

SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof deck.

B. Composite floor deck.

C. Metal form deck.

D. Supplementary framing for openings up to and including 18 inches.

E. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications:

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

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

D. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.

E. SDI - Jobsite Storage Requirements for Steel Deck, 2006.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store deck on dry wood sleepers; slope for positive drainage.

B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 STEEL DECK

A. All Deck Types: Confirm final designations as indicated on structural drawings.

B. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
   2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.

C. Roof Deck: Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 80/550, with minimum G30 galvanized coating.
   2. Primer: SSPC-Paint 15, Type I, cleaned and primed with manufacturer's standard baked -on, rust-inhibitive primer, painted white on bottom.
   3. Minimum Metal Thickness, Excluding Finish: 22 gage or as indicated on the drawings.
   4. Nominal Height: 1-1/2 inch.
   5. Profile: Fluted, Type B wide rib.

D. Canopy Roof Deck: Non-composite type, fluted steel sheet:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS) Grade 80/550 minimum, with G90/Z275 galvanized coating.
2. Minimum Metal Thickness, Excluding Finish: 22 gage, or as indicated on drawings.
3. Nominal Height: See drawings
4. Profile: See drawings

E. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
1. For deck with nominal height of 1-1/2 or 3 inch, as indicated on structural drawings, deck to be inverted type, equal to Vulcraft VLR or Canam Inverted B-Lock.
2. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 40/275 minimum, with G60/Z180 galvanized coating.
   a. Grade as required to meet performance criteria.
3. Primer: Bottom of floor deck shall be pretreated and primed with manufacturer's standard white baked-on rust-inhibitive primer. Top surface shall be unpainted.
4. Minimum Base Metal Thickness: See drawings.
5. Nominal Height: See drawings.
6. Profile: See drawings

2.02 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steel.

2.03 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

B. Roof Sump Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and approved shop drawings. Align and level.

B. Placing of Decking:
1. Position decking on supporting steel framework and adjust to final position with ends bearing on supporting members and aligned end-to-end before being permanently fastened. Roof and composite floor decking shall be continuous over a minimum of three spans.
2. Lap ends of roof decking not less than 4 inches. Butt ends of composite floor decking.
3. Do not stretch or contract side lap interlocks.
4. Place decking flat and square and secure to adjacent framing without warp or deflection.
5. Install deck with corrugations running perpendicular to supports. Lay only as much deck as can be welded during same work period.

C. Fastening Decking - Mechanical Fasteners:
1. Fasten deck to steel support members at ends and intermediate supports with mechanical fasteners. See structural drawings for spacing requirements.
2. Follow manufacturers instructions utilizing installation tool and procedures.
3. Lock side laps between deck supports. See structural drawings for side lap fasteners and spacing requirements.

D. Cutting and Fitting:
1. Cut and fit decking and accessories around projections through decking.
2. Make cuts neat, square and trim.
3. Cut openings in deck true to dimensions using metal saws, drills or cutting torches.
4. Reinforce cuts in decking as indicated on structural drawings.

E. Allow no decking to be used for storage or working platforms until permanently secured in position. Limit loading after securing in place to 20 psf.

F. No decking showing signs of rust shall be installed.

G. See structural drawings for deck reinforcing required at openings.

H. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.

I. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

J. Position roof drain pans with flange bearing on top surface of deck. Mechanically attach at each deck flute.

K. After erection, clean and remove rust, dirt and other foreign matter from exposed surfaces including field connections. Touch-up paint with primer to the same standards as required for the shop coat and paint using identical primer.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

B. Welded Connections: Visually inspect all field-welded connections.

END OF SECTION

SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal framing:
   1. Exterior load-bearing walls
   2. Interior load-bearing walls
   3. Exterior non-load-bearing walls
   4. Exterior or interior curtain walls
   5. Floor joists
   6. Roof rafters and trusses
   7. Ceiling joists
   8. Joist framing and bridging
   9. Shaft wall assemblies

1.02 RELATED REQUIREMENTS

A. Section 09 2216 - Non-Structural Metal Framing: Interior non-load-bearing walls, soffits and suspended ceiling assemblies.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members.

B. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute. (replaced SG-971)

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

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

E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

G. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.

I. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.

J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations and technical data sheets.

C. Shop Drawings: Indicate information on shop drawings as follows:
   1. Submit shop drawings prepared by the manufacturer showing plans, sections, elevations, layouts, profiles and product component locations, including anchorage, bracing, fasteners, accessories and finishes.

a. Show connection details with screw types and locations, weld lengths and locations, and other fastener requirements.
b. Where prefabricated or prefinished panels are to be provided, depict panel configurations, dimensions and locations.

D. Delegated Design Submittals: Submit structural calculations as follows:
1. Structural calculations prepared by manufacturer for approval. Submittal shall be sealed by a professional engineer registered in the State in which the Project is located.
2. Description of design criteria.
3. Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
4. Selection of framing components, accessories and welded connection requirements.
5. Verification of attachments to structure and adjacent framing components.

E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum five years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
1. ClarkDietrich: www.clarkdietrich.com/#sle.
2. Marino|WARE: www.marinoware.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
3. Design Loads: In accordance with applicable codes.
4. Live load deflection meeting the following, unless otherwise indicated:
a. Floors: Maximum vertical deflection under live load of 1/480 of span.
b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
c. Exterior Walls: Maximum horizontal deflection under wind load of 1/360 of span.
d. Interior Walls: Maximum horizontal deflection under wind load of 1/240 of span.
e. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, "C" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As required to meet specified performance levels.
   2. Galvanized in accordance with ASTM A653/A653M, G60/Z180 coating.

B. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G60/Z180 hot dipped galvanized coating.
   1. Gage and Depth: As required to meet specified performance levels.

C. Shaftwall Framing: ASTM C754, C-T shaped profiles, fabricated from ASTM A653/A653M steel sheet, with minimum G40/Z120 hot dipped galvanized coating.
   1. Gage and Depth: As required to meet specified performance levels.

D. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 (minimum),, for 33 and 43 mill members, Grade 50 for 54 mill or heavier with G60/Z180 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
      a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
      b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1 1/2 inch. Confirm anticipated maximum deflection with structural documents.
      c. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.
   4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.05 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated, Drilled expansion bolts, and Screws with sleeves.

PART 3 EXECUTION

3.01 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.

B. Place studs at 16 inches on center, or as indicated on shop drawings; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.

C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

D. Install load bearing studs full length in one piece. Splicing of studs is not permitted.

E. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

F. Align stud web openings horizontally.

G. Secure studs to tracks using fastener method. Do not weld.

H. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

I. Install intermediate studs above and below openings to align with wall stud spacing.

J. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

K. Brace stud framing system rigid.

L. Coordinate erection of studs with requirements of door frames; install supports and attachments.

M. Attach cross studs to studs for attachment of fixtures anchored to walls.

N. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

3.02 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 16 inches on center; not more than 2 inches from abutting walls. Connect joists to supports using fastener method.

D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load bearing studs or provide load distributing member to top of stud track.

3.03 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

E. Space main carrying channels at maximum 48 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

END OF SECTION

SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items, including:
   1. Steel ladder.
   2. Barrier rails.
   3. Bollards.
   4. Miscellaneous steel framing and supports.
   5. Roof opening framing.
   6. Concrete edge confinement angles.
   7. Downspout/roof drain leader guards.
   8. Concrete stair tread nosings.
   9. Elevator hoistway beams.
   10. Steel support for moveable partitions.
   11. Security mesh.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.

C. Section 05 2100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.

D. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.

E. Section 05 5100 - Metal Stairs.

F. Section 09 9113 - Exterior Painting: Paint finish.

G. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

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

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

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

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

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

H. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011 (Reapproved 2015).

I. 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.

J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

K. AWS D1.1/D1.1M - Structural Welding Code - Steel.

L. OSHA-CFR 1910.27 - Fixed Ladders - Supplemental to ANSI A14.3.

M. OSHA-CFR 1910.23 and 1926 - Guarding Floor and Wall Openings.

N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

O. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

1.04 SUBMITTALS

A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

B. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel".

1.06 SEQUENCING AND SCHEDULING

A. Shop Assembly: Preassemble metal fabrications in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark fabricated units for reassembly and coordinated installation.

B. Schedule production and site delivery of metal fabrications so as to avoid delay to other work in which such fabrication are incorporated, and to avoid encumbering site with stored materials.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Steel W Shapes and Tees: ASTM A992/A992M.

E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

F. Fasteners: Provide hot-dipped galvanized fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required..

G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

K. Security Mesh:.

1. Equal to Clark Dietrich Barrier Mesh for Security (BM75), 9 gauge, 3/4 inch diamond pattern, Type II, Class 2 - Galvanized finish.
2. BM-Clips, 2 3/8 inch round galvanized steel clips for attachement

2.02 FABRICATION

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Remove sharp or rough areas on exposed traffic surfaces.

F. Weld corners and seams continuously to comply with AWS recommendations.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

H. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

I. Clearly mark shop assembled and disassembled units for reassembly and coordinated installation.

J. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

L. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish. Unless otherwise shown, provide the following:
   1. Side Rails: 3/8 x 2-1/2 inches, flat bar members with eased edges, spaced at 18 inches.
   2. Rungs: 3/4 inch diameter deformed solid round bar spaced 12 inches on center.
   3. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
   4. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet o.c. Use welded or bolted steel brackets, designed for adequate support and anchorage and to hold the ladder clear of the wall surface with a minimum of 7 inch clearance from wall to centerline of rungs.
   5. Except at roof hatch, extend rails 42 inches above top rung and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.
   6. Fall arrest system.

B. Barrier Rails: Schedule 40 steel pipe and steel channel sections, as detailed; prime paint finish.

C. Bollards: Schedule 40 steel pipe, concrete filled, crowned cap, as detailed; galvanized finish.

D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

E. Roof Opening Framing: As detailed; prime paint finish.
   1. Unless otherwise indicated, provide frame for roof openings 12 x 12 inches or larger in size. Infill frame with 1/2 inch diameter steel bars spaced not over 12 inches on center both ways, unless otherwise indicated.

F. Concrete Edge Confinement Angles: Steel angles; galvanized finish.
   1. Provide loose structural steel angles with integral anchor bolts for confinement and protection of exposed concrete edges as shown. Weld anchor bolts to angles with

equivalent of 3/16 inch full perimeter fillet welds and space as shown, but not closer than 4 inches from ends and corners.

2. Drill and tap angle legs for 1/4 inch by 20 machine screw connection to concrete forms. Provide anchorages at not greater than 48 inches o.c.
3. Miter cut angle legs to form corners and multiple edge intersections as shown.

G. Downspout/ roof Drain Leader Guards: As detailed; galvanized finish.

H. Stair Tread Nosing: Stair nosings shall be equal to type No.BF311D as manufactured by American Safety Tread Company, Helena, Alabama 35080.Telephone 1-800-245-4881. The base shall consist of heat treated extruded aluminum alloy 6063-T6. The abrasive filler shall consist of a mixture of aluminum oxide and silicon carbide granules in an epoxy matrix. Nosings shall terminate not more than 3" from ends of steps for poured concrete stairs; for concrete filled steel pan stairs, nosings shall be full length of steps less 1/8" clearance. Color shall be as selected by the Architect.

I. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

2.04 FINISHES - STEEL

A. Prime paint all steel items except where indicated otherwise.
   1. Exceptions: Galvanize items to be embedded in concrete or masonry.
   2. Exceptions: Do not prime surfaces in direct contact with concrete and where field welding is required.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Prime Painting: One coat, gray metal primer, or approved equal, applied to a minimum dry film thickness of 2.0 mils.

D. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 INSTALLATION OF BOLLARDS AND BARRIER RAILS

A. Temporarily support bollards and barrier posts plumb in each direction and cast integrally with monolithic footings.

B. Fill bollards and barrier posts with 3,000 psi min. 28 day compressive strength concrete as specified under Section 03 3000, "Cast-in-Place Concrete". Form top with compacted smooth and convex surface to shed water.

END OF SECTION

SECTION 05 5100
METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.

B. Stairs with metal treads.

C. Stairs with grating treads.

D. Structural steel stair framing and supports.

E. Handrails and guards.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications.

B. Section 09 9000 - Painting and Coating: Paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

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

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

F. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).

G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

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

I. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

J. 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.

K. 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.

L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel.

N. NAAMM AMP 510 - Metal Stairs Manual.

O. NAAMM MBG 531 - Metal Bar Grating Manual.

P. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual.

Q. OSHA-CFR 1910.23 and 1926 - Guarding Floor and Wall Openings.

R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

S. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

T. SSPC-SP 2 - Hand Tool Cleaning.

1.04 DESIGN REQUIREMENTS

A. Design and fabricate stair assembly to support a uniform live load of 100 lb/sq ft and a concentrated load of 300 lb on an area of 4 square inches, with deflection of stringer or landing framing not to exceed 1/180 of span.

B. Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads:
   1. Top Rail of Guardrail: Uniform load of 50 pounds per linear foot applied in any direction at the top, and a concentrated load of 200 pounds applied in any direction at any point along the top. The concentrated and uniform loads need not be assumed to act concurrently.
   2. Infill Area of Guardrail: Horizontal load of 50 pounds on an area not to exceed 1 square foot, including openings and space between rails. This load need not be assumed to act concurrently with loads on top rails of railing system in determining stress on guard.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
   1. Include the design engineer's stamp or seal on each sheet of shop drawings.

C. Welders' Certificates.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing steel stairs similar to those indicated for this Project with a record of successful in service performance.

B. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

C. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
   1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
   2. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.

B. Metal Jointing and Finish Quality Levels:
   1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
      a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
      b. Welds Exposed to View: Ground smooth and flush.
      c. Mechanical Joints: Butted tight, flush, and hairline.
      d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
      e. Exposed Edges and Corners: Eased to small uniform radius.
      f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.
   1. Tread Pan Thickness: As required by design; 14 gage, 0.075 inch minimum.
   2. Pan Anchorage to Stringers: Welded to carrier angles welded to stringers.
   3. Concrete Finish: Steel troweled.

D. Risers: Same material and thickness as tread pans.
   1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
   2. Nosing Depth: Not more than 1 inch overhang.
   3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Shop- or factory-prime painted.

2.03 METAL STAIRS WITH METAL TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Checkered steel plate.
   1. Tread Thickness: 1/4 inch, minimum.
   2. Nosing: Plate bent to minimum radius with down return of 1 inch.
   3. Anchorage to Stringers: Welded to carrier angles welded to stringers.

D. Risers: Steel sheet.
   1. Riser Thickness: As required by design; 14 gage, 0.075 inch minimum.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Shop- or factory-prime painted.

2.04 METAL STAIRS WITH GRATING TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Grip Strut Safety Grating, regular duty, with slip resistant serrated surface.
   1. Galvanized Steel - hot-dip galvanized before fabrication, ASTM A525 (G-90) standard.
   2. Height: 1-1/2 inches.
   3. Gage: Minimum 12 gage or as required for span.

D. Treads: Steel bar grating.
   1. Grating Type: Welded.
   2. Bearing Bar Depth: 3/4 inch, minimum.
   3. Bearing Bar Spacing: 7/16 inch maximum.
   4. Top Surface: Standard.
   5. Nosing: Checkered plate.
   6. Nosing Width: 1-1/4 inch, minimum.
   7. Openings: Elongations to be perpendicular to direction of travel.
   8. Anchorage to Stringers: End plates welded to grating, bolted to stringers.

E. Stringers: Rolled steel channels.
   1. Stringer Depth: 12 inches.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe railings.

H. Finish: Galvanized after fabrication.

2.05 HANDRAILS AND GUARDS

A. Wall-Mounted Handrails: Round pipe rails unless otherwise indicated.
   1. Nominal Diameter: 1-1/4 inch.

B. Guards - Interior (Square):
   1. Top Rails: Square tube rails unless otherwise indicated.
      a. Nominal Dimension: 1 1/2 inch x 1 1/2 inch x 1/8 inch.
   2. Infill at Pipe Railings: Square tube rails sloped parallel to stair.
      a. Nominal Dimension: 1 1/2 inch x 1 1/2 inch x 1/8 inch.
      b. Jointing: Welded and ground smooth and flush.
   3. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

C. Guards - Exterior (Round):
   1. Top Rails: Round pipe or tube rails unless otherwise indicated.
      a. Nominal Diameter: 2 inch.
   2. Infill at Pipe Railings: Pipe or tube rails sloped parallel to stair.
      a. Pipe Nominal Diameter: 2 inch.
      b. Material: Steel pipe or tube, round.
      c. Jointing: Welded and ground smooth and flush.
   3. End and Intermediate Posts: Same material and size as top rails.
      a. Horizontal Spacing: As indicated on drawings.
      b. Mounting: Welded to top surface of stringer.

D. Fabrication:
   1. Fabricate pipe handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
   2. Interconnect railing and handrail members by butt welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
      a. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, and weld all around.
   3. Form changes in direction of handrails and rails as follows:
      a. By welding in prefabricated flush elbow fittings.
      b. By radius bends of radius indicated.
      c. By flush radius bends.
      d. By bending.
      e. By any method indicated above, applicable to change of direction involved.
   4. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
   5. Provide wall returns at ends of wall-mounted handrails or return handrails and weld to post or railing to create closed shape, unless otherwise indicated.
   6. Close exposed ends of pipe by welding 3/16-inch- (4.8-mm-) thick steel plate in place or with prefabricated fittings.

7. Locate drain or vent holes in pipe in inconspicuous locations. Plug all holes before delivery to site.
8. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and railing systems to other work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.

2.06 MATERIALS

A. Steel Sections: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.

C. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.

D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).

E. Checkered Plate: ASTM A786/A786M, rolled steel floor plate; manufacturer's standard pattern.

F. Safety Grating: Grip Strut Safety Grating, regular duty, with slip resistant serrated surface.

G. Gratings: Bar gratings complying with NAAMM MBG 531 or NAAMM MBG 532, whichever applies based on bar sizes.

2.07 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2, Hand Tool Cleaning.
   2. Number of Coats: One, gray metal primer, or approved equal, applied to a minimum dry film thickness of 2.0 mils.

D. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
   1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval prior to site cutting or creating adjustments not scheduled.

H. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 INSTALLING STEEL PIPE RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
   1. Anchor posts to steel by welding directly to steel supporting members.
   2. Anchor handrail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with drilled-in expansion anchors.

B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with minimum 1-1/2 inch, or as required by code, clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
   1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
   2. For concrete and solid masonry anchorage, use drilled in expansion anchor.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

3.05 SCHEDULES

A. Interior stairs and railings: Prime painted finish.

B. Exterior stairs and railings: Galvanized finish.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheathing.

B. Roof-mounted curbs.

C. Roofing nailers.

D. Preservative treated wood materials.

E. Fire retardant treated wood materials.

F. Communications, security and electrical room mounting boards.

G. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood Protection Association.

D. AWPA C20 - Structural Lumber -- Fire Retardant Treatment by Pressure Processes; American Wood-Protection Association.

E. AWPA C27 - Plywood -- Fire-Retardant Treatment by Pressure Processes; American Wood-Protection Association.

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

G. PS 1 - Structural Plywood.

H. PS 20 - American Softwood Lumber Standard.

I. SPIB (GR) - Grading Rules.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
2. 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.

B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Products shall not contain any added urea-formaldehyde binder or resins (NAUF).

B. Decking at Room Cap :
   1. PS 1, C-D Plugged or better.
   2. Bond Classification: Exposure 1.
   3. Fire Retardant Treated, Class A/Class 1.
   4. Edges: Tongue and groove.

C. Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I, 3/4 inch thick.

D. Communications, Electrical Room, Pump Room and Other Electrical Related 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.

2.04 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: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.05 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.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
   1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
   2. Treat lumber in contact with roofing, flashing, or waterproofing.
   3. Treat lumber in contact with masonry or concrete.

PART 3 EXECUTION

3.01 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.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 INSPECTION:

A. Verify that surfaces to receive rough carpentry materials are prepared to required grades and dimensions.

3.03 INSTALLATION:

A. General:
   1. Accurately cut and fit items with close joints to proper plane and alignment.
   2. Rigidly secure members, free of warp or bend to maintain proper alignment and to adequately resist design loads.
   3. Linear runs of material shall be formed using lengths as great as practicable.
   4. Where multiple members are used to form linear runs, offset joints in member not less than 3 feet.
   5. Roof nailer height shall match the total thickness of insulation being used and shall be installed with a 1/8 inch gap between each length or change of direction.
   6. Roof nailers shall be anchored with fasteners suitable for the application having a minimum withdrawal resistance of 100 lb, staggered 6 inches on center within 8 feet of an outside corners and 12 inches on center along other perimeter areas.

B. Pressure-Treated Wood Products:
   1. Provide pressure-treated wood for all framing, blocking, furring, nailing strips built into masonry walls and wood in contact with concrete.
   2. Install pressure treated wood nailers in locations required by roofing manufacturer including but not limited to:
      a. Perimeter of the roof with gutter.
      b. Base of roof projections.
      c. All roof penetrations.
      d. Expansion joints.
   3. Re-dry and clean lumber, after treatment, to maximum moisture content of 19%, stamped "DRY".
   4. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

3.04 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 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.

C. 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 paneling and trim.
   7. AV Equipment.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and 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.
   4. Size and Location: As indicated on drawings.

END OF SECTION

SECTION 06 4100
ARCHICTECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Wood moldings and trim.

D. Cabinet hardware.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 REFERENCE STANDARDS

A. ANSI A135.4 - American National Standard for Basic Hardboard.

B. ANSI A208.1 - American National Standard for Particleboard.

C. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards.

E. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada.

F. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association.

G. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit samples of plastic laminate and cast acrylic materials.

E. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI (AWS) for Custom Grade.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Composite wood products shall not contain any added urea-formaldehyde binder or resins (NAUF).

2.03 LUMBER MATERIALS

A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade III/Economy; average moisture content of 5-10 percent.
   1. Semi-Exposed Surfaces: Species - clear fir.
   2. Internal Construction: Species - white pine.

B. Interior Woodwork Items:
   1. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI Architectural Woodwork Standards for Custom Grade.
   2. Moldings, Bases, Casings, and Miscellaneous Trim: Clear fir; prepare for stained finish.

C. Interior Wood Trim: Moldings, Bases, Casings, and Miscellaneous Trim.
   1. Clear Maple, shop finish to match wood doors.

2.04 PANEL MATERIALS

A. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with interior grade adhesive under heat and pressure; sanded faces; thickness as required; use for all components not indicated as another material.

B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with interior grade adhesive to suit application; sanded faces; thickness as required.
   1. Use for painted components and components indicated on the drawings.
   2. Use as backing for plastic laminate unless otherwise indicated.

C. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S); use for gables and backs.

2.05 LAMINATE MATERIALS

A. Provide specific types as indicated.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:
   1. General Surfaces: HGS, 0.048 inch nominal thickness, colors as scheduled, finish as scheduled.
   2. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as indicated, finish as indicated.
   3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.06 CAST ACRYLIC COUNTERTOP MATERIALS

A. Provide specific types as scheduled.

B. Provide splash at all flanking walls.

C. Materials: Homogenous solid sheets of filled plastic resin complying with the material and performance requirements of ANSI Z124.3, Type 5 or 6, without a precoated finish.
   1. Thickness: 1/2 inch nominal.
   2. Manufacturer Color: As indicated on Drawings.

2.07 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
   1. Limit VOC to less than 80 g/L.

B. Fasteners: Size and type to suit application.

C. 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.

D. Concealed Joint Fasteners: Threaded steel.

E. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.08 HARDWARE

A. See additional information on drawings.

B. Door Bumpers: Manufacturer's standard resilient permanently raised domes.

C. Adjustable Cabinet Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
   1. Shelf Support Pin/Rest; Knape & Vogt; 332 ANO.

D. Adjustable Shelving Supports: Heavy duty back-mounted system using surface mounted metal shelf standards and coordinated heavy duty cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments. Include clips to screw shelf bracket to shelf.
   1. Standards: #80/85 Ano, double slotted, steel 16 ga, manufactured by Knape-Vogt.
   2. Brackets: #180/185 Ano, double slotted, 2 inch less than shelf depth, manufactured by Knape-Vogt.

E. Drawer and Door Pulls: "U" shaped wire pull, aluminum with satin finish, 4 inch centers.
   1. EPCO EPC-MC402-4-A.

F. Drawer Slides:
   1. Type: Full extension. Ball-Bearing.
   2. Static Load Capacity: Commercial grade.
   3. Mounting: Side mounted.
   4. Finish: Anochrome.
   5. Knape & Vogt; 8400 Full Extension Box or File Drawer Slide.

G. Hinges: European style concealed self-closing type, steel with polished finish.
   1. Manufacturers:
      a. Julius Blum, Inc; Clip Top 170°.: www.blum.com.

H. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.

I. Countertop Brace Mounting Bracket:
   1. Doug Mockett SWS2, 18 - 1/8 inch Inter-Arc Work Support, Matte Black finish.
   2. A&M Hardware, Inc. Standard Workstation and Countertop Bracket, Black finish.

J. Shelf Bracket: Doug Mockett & Co.: #SWS2, 18 x 18 inch with diagonal braces, integral mounting holes, and matte black finish.

K. Cable Access Grommets: Doug Mockett & Co.: Flip Top Series.

2.09 FABRICATION

A. Cabinet Style: Flush overlay.

B. Cabinet Doors and Drawer Fronts: Flush style.

C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

D. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

F. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.

G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

A. AWI Standard: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

B. Conditioning: Condition woodwork to average prevailing humidity conditions for a minimum of seven (7) days in installation areas before installing.

C. Inserts: Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

D. Examination of Woodwork: Before installation of architectural woodwork, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.03 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level. Install to a tolerance of 1/8 inch in 8 feet for plumb and level (including countertops); and with 1/16 inch maximum offset in flush adjoining surfaces.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinets to floor using appropriate angles and anchorages.

F. Standard and Running Trims:
   1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns, miter at corners, and comply with AWI Quality Standards for joinery.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.04 ADJUSTING

A. Adjust installed work.

B. Maximum clearance between doors or jambs and cabinet doors shall not exceed 1/16 inch.

C. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 1300
SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet Waterproofing:

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.

1.03 REFERENCE STANDARDS

A. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems.

B. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

D. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

E. NRCA (WM) - The NRCA Waterproofing Manual.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, and joint and crack sealants.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Grace Construction Products; Based on Bituthane 4000 and Preprufe 300R: www.na.graceconstruction.com.
   2. Carlisle Coatings & Waterproofing Incorporated; MiraPLY-H and MiraPLY-V: www.carlisle-ccw.com.
   3. Henry Company: www.henry.com.
   4. W.R. Meadows, Inc: www.wrmeadows.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MEMBRANE MATERIALS

A. Self-Adhered Sheet Membrane with Weather-Resistant Coating: Recommended by manufacturer for placement below concrete slabs before placement of concrete and on outside face of below grade walls.
   1. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

3.02 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; vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.

B. Roll out membrane, and minimize wrinkles and bubbles.

C. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.

D. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

E. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.

F. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.

G. Seal membrane and flashings to adjoining surfaces.

END OF SECTION

SECTION 07 1616
CRYSTALLINE WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Waterproofing of concrete substrates, using surface application, in the following locations:
   1. Dry side of elevator pits and sump pits.

1.02 SUBMITTALS

A. Product Data: Manufacturers printed data sheet, for specified products.

B. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years experience manufacturing crystalline waterproofing of the type specified, able to provide test reports showing compliance with specified performance characteristics, and able to provide on-site technical representation to advise on installation.

B. Installer Qualifications: Experienced in work of the type specified in this section and approved in writing by waterproofing manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturers original, unopened, undamaged containers with identification labels intact.

B. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.05 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty document executed by authorized company official; warranty period: 5 years commencing on Date of Substantial Completion.

B. Installer's Warranty: Provide warranty signed by installer that reads as follows:
   1. Installer warrants that, upon completion of the work, surfaces treated with crystalline waterproofing will be and will remain free of water leakage resulting from defective workmanship or materials for a period of 5 years from Date of Substantial Completion.
   2. In the event that water leakage occurs within the warranty period from such causes, the installer shall, at his own expense, repair, replace, or otherwise correct such defective workmanship and materials.
   3. Installer shall not be liable for consequential damages.
   4. Installer's liability shall be limited to repair, replacement, or correction of defective workmanship and materials.
   5. This warranty excludes leaks or other defects due to causes beyond the installer's control, including but not limited to structural failure, movement of the structure, fire, earthquakes, tornadoes, and hurricanes.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer: Xypex Chemical Corporation; 13731 Mayfield Place, Richmond, BC V6V 2G9. ASD. Tel: (800) 961-4477 or (604) 273-5265. Fax: (604) 270-0451. E-mail: info@xypex.com. www.xypex.com

B. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

A. Waterproofing: Xypex two-coat crystalline waterproofing.

1. First Coat: Slurry of Xypex Concentrate; proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve the specified coverage with application method used.
2. First Coat Coverage: 1.5 lb/sq yd.
3. Second Coat: Xypex Modified; proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve full coverage with application method used.

B. Dry Pack Repair Compound: Dry pack consistency mixture of Xypex Concentrate; proprietary compound of Portland cement, silica sand and active chemicals; and water in proportions recommended by manufacturer.

C. Patching Compound: Single component, fast-setting, nonshrink, high bond strength hydraulic cement; Xypex Patchn Plug with Xypex Xycrylic Admix where needed for increased bond strength to existing concrete.

D. Slurry Coat: Slurry of Xypex Concentrate; proprietary compound of Portland cement, silica sand and active chemicals, mixed with water in proportions recommended by manufacturer to achieve the specified coverage with application method used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturers instructions.

B. Obtain waterproofing manufacturer's approval of substrates; submit field inspection report.

C. Do not install unless substrate and ambient air temperature are within range acceptable to waterproofing manufacturer.

3.02 PREPARATION OF CURED CONCRETE

A. Prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions.

B. Clean laitance, curing compounds, excess form oil, dirt film, paint, coatings or other foreign matter harmful to the performance of waterproofing from surfaces of cured concrete to be treated.

C. Prepare cured surfaces if necessary to provide open capillary surface to provide tooth and suction for treatment; use acid etching, sandblasting, waterblasting, or other methods.

D. Rock Pockets, Honeycombing, and Other Defective Concrete:
1. Rout out defective areas to sound concrete.
2. Remove loose material and saturate with water.
3. Remove surface water and apply specified slurry coat.
4. After slurry coat has set, but while still green, fill cavity to surface with specified patching compound.

E. Coves: At right-angle intersections cove the joint for smooth transition of waterproofed surface.
1. Apply specified slurry coat to slot at rate recommended by manufacturer.
2. Fill and form surfaces using specified dry pack repair compound or waterproofing material in mortar consistency while slurry coat is still green, but after slurry coat has reached initial set.
3. Trowel into a cove shape.

F. Construction Joints: Apply sealing strips at each construction joint by filling grooves coinciding with construction joint.
1. If grooves have not been preformed, at least 3/4 inch wide and minimum 1 inch deep, saw cut and chip grooves to that dimension.
2. Apply specified slurry coat to slot at rate recommended by manufacturer.
3. Fill and form surfaces using specified dry pack repair compound while slurry coat is still green, but after slurry coat has reached initial set.
4. Compact tightly using pneumatic packer or hammer and block.

3.03 INSTALLATION ON CURED CONCRETE

A. Comply with manufacturers instructions, including product data, technical bulletins, catalog installation instructions, and product carton instructions.

B. Mix materials in accordance with manufacturers instructions.

C. Wet concrete surfaces and saturate with clean water to ensure migration of crystalline chemicals into concrete; remove free surface water before application of waterproofing treatment.

D. Exposed Surface Application: Apply waterproofing uniformly with semi-stiff bristle brush or spray under conditions and application rate recommended by manufacturer.
   1. Apply second coat while first coat is still green, but after reaching initial set.
   2. Use light prewatering between coats when rapid drying conditions occur.

E. Curing: Cure exposed waterproofing treatment using a mist fog spray of clean water after coating has hardened sufficiently not to be damaged by spray; do not use plastic sheeting laid directly on waterproofing; air circulation is required.
   1. If water curing is not possible, follow manufacturer's recommendations for curing using chemical curing agent approved by manufacturer.
   2. Avoid coating damage with spray operation.
   3. Spray treated surface 3 times a day for 2 to 3 days.
   4. In hot climates, spray treated surfaces at intervals recommended by waterproofing manufacturer.
   5. During curing period, protect treated surfaces from rainfall, ambient temperature below freezing, and puddling of water.
   6. Provide supplementary air circulation as recommended by waterproofing manufacturer.

F. Comply with waterproofing manufacturer's recommendations for sequencing construction operations after waterproofing applications to avoid conditions detrimental to performance of waterproofing application.

3.04 CLEANING AND PROTECTION

A. Clean spillage and overspray from adjacent surfaces using appropriate cleaning agents and procedures.

B. Protect installed product from damage during construction; do not allow traffic on unprotected waterproofed surfaces.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt Insulation.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 07 5400: Board insulation specified as part of roof system.

1.03 REFERENCE STANDARDS

A. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

D. FM 4880 - Wall-Ceiling Construction Metal-Faced –Class 1 Fire Rated.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

A. Batt Insulation concealed in walls and soffit:
   1. Type: Unfaced Fiberglass insulation equal to Owens Corning Insulation "EcoTouch Insulation".
   2. Thickness: 3-1/2 or 6-1/4 inch based on framing depth.
   3. Minimum R Value: 13 or 19 respectively.

B. Batt Insulation exposed in plenum or occupied space:
   1. Type: Fiberglass insulation equal to Owens Corning Insulation "Flamespread 25".
   2. Thickness: 3-1/2 or 6-1/4 inch based on framing depth.
   3. Minimum R Value: 13 or 19 respectively.
   4. Vapor Barrier: Foil scrim faced with flame spread rating not to exceed 25 and maximum smoke developed of 50.

C. Exposed Batt Insulation attached to inside face of wall:
   1. Type: Unfaced fiberglass insulation equal to Owens Corning Insulation "EcoTouch Insulation"
   2. Thickness: 6-1/4 inch.
   3. Width: 4 foot.
   4. Minimum R Value: 19.
   5. Vapor Retarder/Facing: Applied over exposed surface.

D. Acoustic Batt Insulation:
   1. Type: Unfaced sound attenuation fiberglass batt insulation equal to Owens Corning Insulation "EcoTouch Sound Attenuation Batts (SAB'S)".
   2. Thickness: 3-1/2 inch.

E. Acoustic Batt Ceiling Insulation, not in return air plenum:
   1. Type: Unfaced sound attenuation fiberglass batt insulation equal to Owens Corning Insulation "EcoTouch Sonobatts Insulation".
   2. Thickness: 3-1/2 inch.

3. Size: To fit above standard ceiling tiles.
4. Minimum R Value: 13.

F. Accessories:
1. Stick Pin:
   a. Insulation Fasteners: Impaling clip of galvanized steel , to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, with washer retainer capable of securely and rigidly fastening insulation in place. Equal to Midwest Fasteners - Spindle - IHSP.
   b. Washer Retainer - Exposed to View: Equal to Midwest Fasteners - Capped Speed Washer - PCW, decorative domed cap, aluminum with white finish.
   c. Washer Retainer - Concealed from View: Equal to Midwest Fasteners - Self-Locking Square Washer - WA/WS, aluminum with with stainless steel.
   d. Adhesive: High strength specifically intended for this purpose, and approved by manufacturer.
2. Sheet Vapor Retarder: NAIMA approved, composite vapor retarder composed of 0.0015 inch white polypropylene film, a reinforcing layer, and 0.0005 inch metallized polyester film. complying with applicable provisions of ASTM C991, Type 1, and as follows:
   a. Product: Lamtec WMP-VR-R Plus, or as approved.
      1) Perm rating: 0.02
      2) Width: 54 inch rolls.
      3) Color: White.
      4) Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 450, respectively.
   b. Tape for Vapor Retarder: Pressure sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.
3. Sheet Metal J-Trim: White prefinished 24 gauge sheet metal as shown on drawings.
4. Acoustic Selant: Nonhardening, permanently resilient equal to Ownes Corning QuietZone Acoustic Sealant.

PART 3 EXECUTION

3.01 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Walls and Soffits with Metal Stud Framing:
1. Install insulation with vapor barrier towards building interior.
2. Use friction fit between framing members.

F. Exposed Insulation Attached to Concrete Walls:
1. Install insulation with vapor barrier towards building interior.
2. Install batt insulation to wall with insulation hangers and plastic washers. Hangers shall be equally spaced at a rate of approximately 1 fastener per 8 square feet of wall area, 3 foot x 3 foot grid per 4 foot wide roll.
3. Provide J-trim at all exposed edges in warehouse.
4. Install vapor retarder without sags or wrinkles, and with 6 inch minimum side and end laps. Install in longest, continuous sheets as practicable, with sheet edges properly aligned, plumbed horizontally and vertically.

G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

H. Provide uniform, neat appearing vapor retarder installation upon completion, with clean-cut, square edges.

I. At partitions calling for acoustic insulation, provide acosutic sealant at gaps between wall stud plates and floor, around electrical boxes, around air ducts and boots, around doors and windows, and any other miscellaneous wall, ceiling and floor penetrations or gaps.

J. Install insulation above acosutic ceiling tile fit tightly together. Cooridinate with lighting fixtures for required clearances.

3.02 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 2500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, joints around frames of openings in exterior walls, and soffits water vapor-resistant and air tight.

1.02 RELATED REQUIREMENTS

A. Section 07 2616 - Vapor Retarder: Vapor retarder installed as a portion of the slab on ground system.

B. Section 07 5400 - Thermoplastic Membrane Roofing: Vapor retarder installed as part of roofing system.

1.03 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. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on material characteristics.

C. Manufacturer's Installation Instructions: Indicate preparation.

PART 2 PRODUCTS

2.01 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      a. Dry Film Thickness (DFT): 20 mil, 0.020 inch, minimum.
      b. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
      c. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F.
      d. Manufacturers:
         1) DuPont de Nemours, Inc; Tyvek Fluid Applied WB+ with Tyvek Fluid Applied Flashing and Joint Compound, Sealant for Tyvek Fluid Applied System, and StraightFlash: building.dupont.com/#sle.
         2) GCP Applied Technologies; Perm-A-Barrier VPL: www.gcpat.com/#sle.
         3) Henry Company; Air-Bloc All Weather STPE: www.henry.com/#sle.
         4) Master Builders Solutions by BASF; MasterSeal AWB 660: www.master-builders-solutions.basf.us/en-us/#sle.
         5) Polyguard Products, Inc; Airlok STPE WRB Spray-n-Roll: www.polyguardproducts.com/#sle.
         6) Substitutions: See Section 01 6000 - Product Requirements.

2.02 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.

PART 3 EXECUTION

3.01 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. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.

D. 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 at least 4 inches wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal weather barrier to all sides 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.

3.02 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 2616
VAPOR RETARDER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. Vapor retarder to be placed under interior concrete slabs on grade where indicated.

1.02 RELATED REQUIREMENTS:

A. Section 07 2500 - Weather Barriers: Materials to make exterior walls, joints between exterior walls and roof, joints around frames of openings in exterior walls, and soffits water vapor-resistant and air tight.

B. Section : 07 5400 - Thermoplastic Membrane Roofing: Air barrier beneath rigid insulation at roofing systems.

1.03 REFERENCES:

A. A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
   2. ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slab.
   3. ASTM 154 Standard Test Methods for Water Vapor Retarders used in contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's product literature and instructions for vapor retarder material, tape and mastic.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to project site in manufacturer's original packaging or containers.

B. Store to prevent damage, deterioration or contamination.

PART 2 - PRODUCTS

2.01 VAPOR RETARDER:

A. Acceptable Manufacturer:
   1. Stego Industries: Stego Wrap Vapor Barrier.
   2. Fortifiber Industries: Moistop Ultra 15.
   3. Viper: Vaporcheck II.
   4. Substitutions: None allowed.

B. Requirements:
   1. Permeance of less than 0.01 perms as tested in accordance with ASTM E 154.
   2. Strength: Class A requirements of ASTM E 1745.
   3. Minimum Thickness: 15 mil.

C. Adhesive or Tape: Acceptable to manufacturer of vapor retarder material.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install vapor retarder over compacted, clean subgrade material, free of debris and protrusions.

B. Lay vapor retarder over interior building area to receive concrete slab; lap edges 6" minimum and seal with manufacturer's tape. Lay membrane with seams perpendicular to and lapped in direction of placement. Turn edges of membrane up to within 1/2" of top of slab at intersection with vertical surfaces.

C. Where expansion, construction or contraction joints are indicated in slab, lay vapor retarder continuous under joint filler.

D. Seal openings in vapor retarder around pipes and other protrusions per manufacturer's instructions. Fold at corners to form envelopes.

E. Protect vapor retarder installation from damage until concrete slab is in place.

END OF SECTION

SECTION 07 4213.23
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior curtain wall system consisting of formed metal composite material (MCM) sheet, framing, secondary supports, and anchors to structure.

1.02 RELATED REQUIREMENTS

A. Section 07 2500 - Weather Barriers: Weather barrier behind wall panel system.

B. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 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).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.

F. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

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

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

I. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

N. ASTM D523 - Standard Test Method for Specular Gloss.

O. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives.

P. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics.

Q. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

R. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.

S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

T. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

U. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   4. Review procedures for protection of work and other construction.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.

D. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.

E. Test Report: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.

F. Maintenance Data: Care of finishes and warranty requirements.

G. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.

3. Store at a slope to ensure positive drainage of any accumulated water.
4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
   1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material Sheet Manufacturers:
   1. Alcan Composites USA, Inc; : www.alucobondusa.com.
   2. Alcoa, Inc; : www.alcoa.com/#sle.
   3. ALPOLIC Materials: www.alpolic-americas.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Provide panel jointing and weatherseal using reveal joints and gaskets but no sealant.
   2. Anchor panels to supporting framing without exposed fasteners.

B. Performance Requirements:
   1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
   2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
      a. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
      b. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
      c. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
   3. Fire Performance: Tested in accordance with, and complying with acceptance criteria of NFPA 285.

2.03 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic fire resistant (FR) core material; no foamed insulation material content.
   1. Overall Sheet Thickness: 4 mm, minimum.
   2. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to

panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.

3. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
4. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
5. Custom Fluoropolymer Coating System: Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as indicated on drawings.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
3. Stainless Steel Sheet Components: ASTM A480/A480M.
4. Aluminum Components: ASTM B209 (ASTM B209M); or ASTM B221 (ASTM B221M).

2.04 FINISHES

A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, with at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mils, 0.0009 inch; color and gloss as indicated on drawings.
1. Custom color. Only Tenant pre-approved documented samples will comply. Multi-coat system to comply with warranty and color matching.

2.05 ACCESSORIES

A. Anchors, Clips and Accessories: Use one of the following:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.
2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
3. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A123/A123M Coating Grade 10.

B. Fasteners:
1. Exposed Fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
3. Bolts: Stainless steel.

C. Provide panel system manufacturer's and installer’s standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.

C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

H. Replace damaged products.

3.04 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 4214
INSULATED METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory-assembled, laminated, insulated, metal panel system for walls, with trim, related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Structural Steel: Structural steel building frame.

B. Section 05 4000 - Cold-Formed Metal Framing: Stud framing system, delegated design.

C. Section 07 6200 - Sheet Metal Flashing and Trim.

D. Section 07 8400 - Firestopping.

E. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

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

B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

1.04 PRE-INSTALLATION MEETING

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on assembled panel structural capabilities.

C. Shop Drawings: Submit detailed drawings and panel analysis showing:
   1. Profile
   2. Gauge of both exterior and interior sheet
   3. Location, layout and dimensions of panels
   4. Location and type of fasteners
   5. Shape and method of attachment of all trim
   6. Locations and type of sealants
   7. Installation sequence
   8. Coordination Drawings: Provide elevation drawings and building sections which show panels in relationship to required locations for structural support. Include panel details and details showing attachment to structural support.
   9. Other details as may be required for a weathertight installation

D. Samples: Submit two samples of panel, 3x3 inch minimum size, illustrating finish color, sheen, and texture.

E. Design and Performance Data: Indicate panel profile and dimensions and structural properties.
   1. Panel Analysis: Provide panel calculations to verify panels will withstand the design wind loads indicated without detrimental effects or deflection exceeding L/180. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.

F. Manufacturer's Installation Instructions: Indicate special handling criteria.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum five years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Prevent contact with materials that could cause discoloration or staining.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's finish warranty of 20-20-20 year (film integrity - color/fade - chalk)

C. Workmanship warranty, correct defective work within a 2 year period after Date of Substantial Completionboth manufacturer and installer including:
   1. Degradation of panel finish including color fading caused by exposure to weather.
   2. Failure of water tightness, loss of integrity of seals .

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: www.kingspanpanels.us.
   1. Kingspan KS Series; Mini Micro-Rib
   2. Benchmark; Designwall 2000 Flat and 2000R Ribbed Panel

B. Other Acceptable Manufacturers:
   1. Centria: www.centria.com/#sle.
      a. Versawall H+
      b. Formawall Dimension Series; FWDS for Flat and DS60 for Ribbed
   2. Metl-Span, a Division of NCI Group, Inc: www.metlspan.com/#sle.
      a. Striated
      b. CF Architectural for flat, and 7.2 Insul Rib for ribbed
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEM

A. Metal Panel System: Factory-assembled metal panel system, with trim, related flashings and accessory components.
   1. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   2. Accommodate tolerances of building structural framing.

B. Performance Requirements:
   1. Thermal Performance: Provide thermal resistance through entire system (R-value) of 19 deg F hr sq ft/Btu, minimum, based on indicated panel thickness.
   2. Structural Performance: Design and size to withstand all dead loads and wind loads caused by positive and negative wind pressure acting normal to plane of panel.
      a. Verify structural performance in accordance with ASTM E330, using test pressure 1.5 times design wind pressure, with 10 seconds duration of maximum load.
      b. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
   3. Movement: Accommodate the movement caused by the following without damage to system, components, or deterioration of seals:
      a. Normal movement between system components.
      b. Seasonal temperature cycling.
      c. Deflection of structural support framing,

2.03 PANELS AND TRIM

A. Wall Panels: Exterior and interior metal sheet skin, factory-assembled, with foamed in place insulation; exterior and interior sheet interlocking at edges, manufacturer's standard sealant .
   1. Panel Width: As indicated on drawings

2. Profile: Horizontal panels, as indicated on drawings
3. Panel Thickness:
   a. Type A - Mini Micro-Rib: R-Value 21
   b. Type B - Designwall 2000 Flat: R-Value 21
   c. Type B - Designwall 2000R Ribbed Panel: R-Value 14
4. Exterior Sheet: Pre-finished galvanized steel:
   a. Mini Micro-Rib: minimum 24 gage thick
   b. Designwall 2000 Flat and 2000R Ribbed Panel: minimum 22 gage thick
5. Interior Sheet: Galvanized steel, pre-finished, minimum 24 gage thick.
6. Panel Edge Profile: Tongue and groove, for flush seam.
7. Exterior Finish: Polyvinylidene fluoride (PVDF) coating; texture and color as selected and indicated on drawings.
   a. Standard colors, based on basis of design selections.
   b. Custom color. Only Tenant pre-approved documented samples will comply. Multi-coat system to comply with warranty and color matching.
8. Interior Finish: Silicone polyester coating; color as selected from manufacturer's standard range.

B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as exterior sheets; factory-fabricated to required profiles; fabricated in longest practicable lengths.

2.04 PANEL MATERIALS

A. Precoated Galvanized Steel Sheet: ASTM A653/A653M, Commercial Steel (CS) or Forming Steel (FS), with G90/Z275 coating; continuous-coil-coated with acrylic primer coat, silicone polyester or polyvinyl fluoride (PVF) top coat, and polyester washcoat for panel back.

B. Foamed-in-Place Insulation: Manufacturer's standard Polyisocyanurate or Urethane type.

C. Gaskets: Manufacturer's standard type suitable for use with panel system, permanently resilient; ultraviolet and ozone resistant; .

D. Panel Sealants: Manufacturer's standard type suitable for use with installation of panel system; non-staining, skinning, non-shrinking, non-sagging; ultra-violet and ozone resistant; .

2.05 ACCESSORIES

A. Concealed Sealants: Non-curing butyl sealant or tape sealant.

B. Anchors: Galvanized steel.

C. Fasteners: Manufacturer's standard type to suit application; of hot-dip galvanized steel or stainless steel.

D. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that structural framing is ready to receive panel system.

3.02 INSTALLATION

A. Install panel system on walls in accordance with manufacturer's instructions.

B. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.

C. Locate panel joints over supports.

D. Provide for expansion joints where indicated.

E. Use combination concealed and thru wall fasteners to satisfy windload requirements.

F. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.03 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.04 CLEANING

A. Remove site cuttings from finish surfaces.

B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

3.05 SCHEDULES

A. Confirm with drawings:

END OF SECTION

SECTION 07 5400
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. TPO Mechanically Fastened, or Induction Welded fastened membrane roofing system.

B. Insulation, flat and tapered.

C. Roofing stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Pre-Installation Meeting.

B. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.

C. Section 07 6200 - Sheet Metal Flashing and Trim: Flashings, counterflashings, downspouts, conductor heads, and copings.

D. Section 07 7200 - Roof Accessories: Roof hatch and railings.

E. Section 09 2116 - Gypsum Board Assemblies: Exterior sheathing.

1.03 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.

B. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.

C. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. FM DS 1-28 - Wind Design.

E. NRCA (RM) - The NRCA Roofing Manual.

F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual.

G. UL (DIR) - Online Certifications Directory.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene two weeks before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.

C. Specimen Warranty: For approval.

D. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and mechanical fastener layout.

E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.

F. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.

B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.
   1. With minimum 5 years documented experience.

2. Approved by membrane manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.

B. Store products 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.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. System Warranty: Provide manufacturer's total 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.
   3. The maximum wind speed coverage shall be peak gusts of 72 mph measured at 30 feet above ground level.
   4. Pro-rated membrane system warranties shall not be accepted.
   5. The roofing system manufacturer’s warranty shall include roof edge metal and the installation of that edge metal in the warranty. See Section 07 6200 - Sheet Metal Flashing and Trim.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Thermoplastic Polyolefin (TPO) Membrane Materials:
   1. Carlisle Roofing Systems, Inc.
   2. Firestone Building Products, LLC
   3. GenFlex Roofing Systems, LLC
   4. Johns Manville.
   5. GAF; EverGuard TPO: www.gaf.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING

A. Thermoplastic Membrane Roofing: One ply membrane, mechanically attached or induction welded mechanically fastened, over insulation.

B. Roofing Assembly Requirements:
   1. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980.
      a. Field applied coating may not be used to achieve specified SRI.
   2. Roof Covering External Fire Resistance Classification: UL Class A.
   3. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
   4. Ground Roughness: Class C
   5. Factory Mutual Classification: Contractor to supply Class I and windstorm resistance in compliance with FM DS 1-28 and ASCE 7-16.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M.
   2. Reinforcing: Internal fabric.
   3. Thickness: 0.060 inch, minimum.
   4. Sheet Width: Maximum 8 feet, factory fabricated. If induction welded system is used for membrane fastening, sheets may be wider.
   5. Color: White.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended and approved by membrane manufacturer.

D. Flexible Flashing Material: Same material as membrane.

E. Waterproof Membrane Material at parapets and curbs: Same material as membrane, fully adhered.

F. Flexible Expansion Joint Cover: Flexible, weather-proof curb mounted cover system based on Johns Manville "Curb-to-Curb CF" with aluminum flanges.

2.04 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 1, glass fiber mat both sides.
   1. Provide tapered boards where indicated for sloping to drain. Fabricate with taper of minimum of 1/2 inch per foot, unless indicated otherwise. Minimum thickness shall be 1/4 inch.
   2. Minimum Compressive Strength: 20psi
   3. Roof:
      a. Board Size: Maximum 48 x 96 inch.
      b. Thermal Resistance: Total R-value of 30.
      c. Minimum 2 layers.
   4. Parapet and Curbs:
      a. Primed face to receive adhered membrane.
      b. Thermal Resistance: Total R-value of 8.6, based on 1 1/2 inch thickness.

2.05 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.
   2. Minimum fastener size shall be no less than #14 fasteners.

C. Membrane Adhesive: As recommended by membrane manufacturer.

D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

F. Spray Foam Insulation: As recommended by insulation manufacturer and membrane manufacturer.
   1. To be provided in ASHRAE Climate Zones 4a and higher at perimeter, penetrations, curbs, roof drains, and for all gaps 1/4 inch or greater in the insulation boards.

G. Roofing Nails: Galvanized, hot dipped type, size and configuration as required to suit application.

H. Termination Bars: As recommended by membrane manufacturer.

I. Sealants: As recommended by membrane manufacturer.

J. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Size: Manufacturer's standard size(s).
   3. Surface Color: White or grey.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

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.

3.02 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 nailing strips are in place.

F. Verify that positive roof slope exists in all areas.

G. Verify location, dimensions and elevations of primary and secondary roof drainage components including roof drains and overflow scuppers.

H. Correct unsuitable conditions before proceeding with installation. Commencing installation signifies acceptance by the installer of the substrate.

3.03 SUBSTRATE PREPARATION

A. Prior to the start of work, make the substrate smooth and free of debris, sharp edges, and other surface irregularities that will be detrimental to the installation.

B. Correct unevenness and joint gaps greater than 1/4 inch in the membrane substrate as they can cause inconsistent membrane welds. When such conditions occur fill with appropriate and properly secured insulation or material approved by manufacturer's technical review department.

C. Nailers: Verify that:
   1. Nailers are installed at gravel stops and drip edges.
   2. Nailers are pressure-preservative treated (fire-retardant-treated where required; creosote and asphaltic preservatives are not acceptable).
   3. Nailers are anchored with fasteners suitable for the application having a minimum withdrawal resistance of 100 lb, staggered 6 inches on center within 8 feet of an outside corners and 12 inches on center along other perimeter areas.
   4. Top surfaces of nailers match the top surface of adjacent construction plus/minus 1/4 inch, without contributing to ponding.

D. Flashing Substrates: Verify that the substrate is smooth and free of sharp edges and other surface irregularities that will be detrimental to 100-percent adhesion of the flashing membrane.

3.04 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Do not apply roofing membrane during unsuitable weather.

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.

3.05 FASTENERS - GENERAL

A. Install fasteners with a depth-sensing screw gun to prevent overdriving or underdriving, unless otherwise approved or required by project conditions.

3.06 INSULATION APPLICATION - UNDER MEMBRANE

A. Install air barrier to deck surface, extending over the entire roof and out to deck edge. Turn air bairrier up at parapet walls. Lap and seal to provide continuity of air barrier plane.

B. Attachment of Insulation:
   1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
   2. Use minimum six fasteners per board.

C. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.

D. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

E. Handle and secure insulation boards so as to not damage or rupture the facer and surface. Cut out damaged areas and replace with structurally sound insulation, properly secured in place.

F. Install boards with the longest dimension perpendicular to the direction of the membrane seams and with end joints staggered. Butt boards as closely as possible with no gaps over 1/4 inch.

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches from the clamp ring. Custom trim the lower edges immediately surrounding the drain bowl, and any hard edge between the flat panel and the tapered panel surface to provide a smooth, sloping transition. Miter corners of the tapered insulation panels with a 45 degree angle cut.

I. Fill gaps between boards and between boards and abutting vertical surfaces with spray-foam insulation.

J. Do not apply more insulation than can be covered with membrane in same day.

3.07 MEMBRANE APPLICATION

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. Overlap edges and ends and seal seams by heat welding, minimum 3 inches overlap. Seal permanently waterproof.
   1. Use hand-held welders for small work and repairs.
   2. Use automatic hot-air welders for field seaming. All seams are to be welded a minimum of 1 inch from edge of lap joint.
   3. The equipment settings and alignment adjustments must be checked continuously during each day to insure complete fusion within the welded area and a smooth, wrinkle-free seam.
   4. The seams shall be checked for continuity and integrity. All imperfections shall be corrected.
   5. Caulk cut edges.

D. Mechanical Attachment: Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

E. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 8 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. On all curbs the flashing shall be bonded to the roofing membrane and turned up the curb and terminate beneath the curbs or mechanical equipment curb cap flashing.

F. Around roof penetrations, seal flanges and flashings with flexible flashing.

G. Roof Drains: Install in accordance with membrane manufacturer's details.
   1. Properly secure all bolts to provide 100-percent continuous compression of the clamping ring.
   2. Do not run field seams through drains.
   3. Insulation shall be tapered around the drain to provide positive drainage, prevent the membrane from bridging, and provide a smooth transition from the roof surface to the drain clamping ring.
   4. The seal between the membrane and the drain base shall be provided by polysulfide or polyurethane sealant under constant, even compression from the drain clamping ring.
   5. Where detailing drains, install a new target patch of PVC membrane, within the entire sumped profile. Cut a circular sheet opening of a diameter slightly greater than drain pipe diameter. Bolt holes within the new membrane shall be cut round only, no straight or cross cuts allowed.
   6. Cut membrane neatly to provide full acces to drain outlet pipe.

H. Metal Work:
   1. Install and anchor in a manner that prevents damage from buckling or wind, in accordance with SMACNA guidelines or in manner approved by membrane manufacturer.
   2. Seal and waterproof in an acceptable manner to prevent leakage.
   3. Make and install edge metal assemblies at perimeter in accordance with membrane manufacturer's details.

I. Roof Walkway Pads: Install pads in accordance with roofing manufacturer's instructions.
   1. Install walkway pads extending 4 feet from the service panels of all roof mounted equipment and at the roof access landing.
   2. Prepare dirty or weathered membrane, removing visible dirt and debris.
   3. Position walkway pad and cut to desired length.
   4. Whenever possible, do not cover membrane seams with walkway pad. When installed adjacent to a seam, keep the pad a minimum of 2 inches from the edge of the seam on the bottom sheet of the completed lap and a minimum of 6 inches from the edge of the seam when located on the top sheet of a completed lap.
   5. When covering seams is unavoidable, the lap seam should be completed per manufacturers recommendations, and thoroughly probed with any deficiencies repaired prior to pad installation.
   6. In circumstances where drainage around the walkway pad is a concern, shorter walkway pad lengths spaced with a 2 inch gap may be desired.
   7. Weld perimeter of walkway pad to the membrane following standard welding procedures. Periodic breaks in the weld of 1 to 2 inches are required on the low slope edge of the pad to prevent the accumulation of water under the pad.

3.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
   1. Owner shall employ and pay for services of an independent Roofing Consultant to review roof submittals, attend pre-roofing meeting, provide on-site inspections (minimum of 1 trip per week) and provide Punch List. Inspections shall be performed by a Registered Roof Observer (RRO) as recognized by the Roofing Consultants Institute.

B. Ensure that metal work shall be secured in a manner approved by roof manufacturer, or in accordance with SMACNA guidelines, to prevent damage from buckling, or wind exposure. All metal work that is part of the waterproofing envelope shall be sealed, structurally sound, and appropriately anchored to prevent leakage.

C. Tests:
   1. Seam Tests: Probe the entire lap edge of each seam with an approved seam probing tool after seam has cooled completely to verify seam consistency. Probing before the seam area has cooled will damage the membrane.

D. Manufacturer's Field Service: Upon completion of the installation, have the manufacturer's representative make an inspection to ascertain that the roofing membrane system has been installed according to manufacturer's approved specifications and details.

E. Warranty Inspection: Provide copy of manufacturer's inspection for acceptance for warranty.

F. Rejection of Defective Work: Areas having excessive patching as a result of damage to the membrane or faulty installation may be rejected by membrane manufacturer or the Architect; replace the membrane completely in these areas.

3.09 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 conform to their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.10 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 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings and counterflashings.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.

B. Section 07 5300 - Single-Ply Membrane Roofing - EPDM.

C. Section 07 5400 - Thermoplastic Membrane Roofing: Roofing system

D. Section 361 - Joint Sealers.

1.03 REFERENCE STANDARDS

A. ANSI/SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

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

C. CDA A4050 - Copper in Architecture - Handbook.

1.04 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Submit manufacturer's full range of color options for Architect selection.

C. Warranty Specimen: For approval.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Roof edge metal assemblies including copings, fascias and gravel stops shall be designed in accordance with ANSI/SPRI ES-1.

1.06 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.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warrant flashing and sheet metal work to be free of defects in materials and workmanship for a period of two years from Date of Substantial Completion.

C. Roof edge metal assemblies shall be included in the roof system warranty.

D. Prefinished Metal: Warrant against fading and peeling for a period of 10 years.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A 653/A 653M, with G90/Z275 zinc coating; minimum.0239 inch (24 gage) 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; color as selected from manufacturer's standard colors.

2. Underside shall be coated with manufacturer's standard wash coat.

B. Birdscreen: Equal to McNichols 36889110041, 1 1/2 inch square mesh, 0.135 inch diameter wire.

2.02 FASTENERS:

A. Generally composed of same materials as flashings being fastened. Exposed fasteners shall have 5/8 inch steel/neoprene washers under the head. Fasteners shall be treated for resistance to rust and corrosion.
   1. Sheet Metal to Wood:
      a. Concealed Application: Annular threaded nail with minimum 3/16 inch diameter head, not less than 12 gauge and of sufficient length to penetrate substrate 1-1/4 inch minimum.
      b. Exposed Application: No. 10 screws minimum. Penetrate wood blocking minimum 1-1/2 inches. Installed withdrawal resistance shall be a minimum of 150 pounds per screw.
   2. Sheet Metal to Sheet Metal: Self-tapping sheet metal screws of 1/2 inch length and a minimum No. 8 diameter.
   3. Concrete and Masonry Anchors: Specially threaded anchors, 3/16 inch minimum diameter, length to penetrate minimum 1-1/2 inches into concrete or masonry. Installed withdrawal resistance shall be a minimum of 150 pounds per anchor.

2.03 FABRICATION

A. Shop fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.

B. Provide gage suitable for purpose as recommended by SMACNA Manual.

C. Form sections true to shape, accurate in size, square, and free from distortion or defects.

D. Form pieces in longest possible lengths.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Fabricate corners from one piece with minimum 4 inch nor more than 12 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

H. Blind clips and cleats shall be at least the same gauge as sheet metal flashing.

I. Paint birdscreen.

2.04 SCHEDULE

A. Downspouts:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 1-32B.

B. Downspout Hangers:
   1. Material: Galvanized steel, 20 gage.
   2. Design: SMACNA Figure 1-35A.

C. Gravel-Stop Fascia:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 2-1B.

D. Coping:
   1. Material: Galvanized steel, minimum 24 gage.
   2. Design: SMACNA Figure 3-4A; slope top 1/2 inch.
   3. Joint Design: SMACNA Figure 3-3, style 19; butt seam with 12 inch wide backup plate. Fabricate in 10 foot lengths with 1/2 inch minimum joint for expansion and contraction.

E. Overflow Scupper:
   1. Material: Galvanized steel, 24 gage, soldered construction.
   2. Design: SMACNA Figure 1-30, modified in accordance with details indicated on Drawings.
   3. Fabricate scuppers with minimum 4" wide roof side flange. Cross section of scupper shall be ½" less in width and height than the parapet opening.

F. Roof Edge Trim:
   1. Material: 20 gage galvanized rail, 24 gage prefinished metal fascia cover
   2. Product: Metal Era - Custom One Edge, mechanically fastened to masonry/tilt-panel
   3. Face Profile: Dimension as indicated on drawings

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Except as otherwise indicated, comply with the installation recommendations of SMACNA and Factory Mutual Data Sheet 1-49 Perimeter Flashing.

B. Coordinate flashing at roof surfaces with roofing work to provide weather-tight condition at roof terminations.

C. Sheet metal items shall be installed true to line, without buckling, creasing, or warp.

D. Anchor units of work securely in place, providing for thermal expansion of metal units. Conceal fasteners where possible. Exposed fasteners shall be covered with sealant.

E. Fastening:
   1. Nails: Confine to one edge only of flashing 12" or less in width. Space nails at 4" o.c. maximum.
   2. Cleats: Continuous, formed to profile of item being secured.
   3. Clips: Minimum 2" wide by 3" long formed to profile of item being secured. Space at 24" o.c. maximum except as otherwise indicated.

F. Downspouts:
   1. Secure downspouts to exterior walls at 10 feet on center maximum. Lap downspout joints 1-1/2 inch and rivet.
   2. Provide downspout terminations at grade. Provide connection to underground storm drain system where indicated on Drawings. Extend 2 inches into pvc cap, and apply sealant all around.

G. Roof Penetration Flashing: Flash and install penetrations in accordance with sheet roofing manufacturer's product data.

END OF SECTION

SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Curbs.

B. Roof hatches, manual and automatic operation, including smoke vents.

C. Roof walkways and platforms.

D. Roof Access Ladder and Crossover.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 DESIGN REQUIREMENTS - ACCESS LADDER AND CROSSOVER

A. Provide roof access ladder and crossover systems as fully designed assemblies, locations as indicated on drawings. Based on information indicated on drawings.

B. Engineer, fabricate, and install systems to comply with local codes.

C. Compliant with OSHA 1910 Subpart D for walking and working surfaces.

D. Intent is that the assembly does not penetrate the roofing system.

E. Seismic restraint as required.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.

C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
   1. Design, details and calculations.
   2. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.05 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.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Manufacturers:
   1. AES Industries Inc: www.aescurb.com/#sle.
   2. Substitutions: See Section 01 6000 - 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. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
   3. Provide for layouts and configurations as indicated on drawings.
   4. Curb Height: 18" from surface of roof deck, minimum.

2.02 ROOF ACCESS LADDERS AND CROSSOVERS

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. MIRO Industries, Inc.: miroind.com
      b. PHP Systems Design: www.phpsd.com
      c. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Walkways and Platforms: Non-penetrating, mechanically attached walkway system installed over standing seam metal roofs.
   1. Dimensions: As indicated on drawings.
   2. Grating Length: Manufacturer's standard length.
   3. Walking Surfaces: 18 gauge, 0.0478 inch hot dip galvanized steel grating at G90 in accordance with ASTM A653/A653M, either formed plank grating or welded bar grating, with anti-skid surface and handrails at locations indicated on drawings.
   4. Provide support plate assemblies and attachment hardware in compliance with manufacturer's written instructions in accordance with installation requirements.
   5. Access Ladder:
      a. Landing with guardrails, ladder to roof deck below.
      b. Provide clearance at building walls and roof deck to avoid abrasion and damage.
   6. Crossover:
      a. Landing with ramp and guardrails to provid access over roof expansion joints.
      b. System to provide movement of expansion joint. System is not to slide on roof membrane.
      c. Provide clearance of expansion joint and curb.
   7. Accessories:
      a. Support pads to protect roof
      b. Slip pads to protect roof
      c. Adhesives

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

B. Apply bituminous paint on surfaces of units in contact with cementitious materials or dissimilar metals.

END OF SECTION

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.

D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

E. ITS (DIR) - Directory of Listed Products.

F. FM (AG) - FM Approval Guide.

G. FM P7825 - Approval Guide; Factory Mutual Research Corporation.

H. SCAQMD 1168 - Adhesive and Sealant Applications.

I. UL 1479 - Standard for Fire Tests of Penetration Firestops.

J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.

K. UL (DIR) - Online Certifications Directory.

L. UL (FRD) - Fire Resistance Directory.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number. Show locations on plan.

C. Product Data: Provide data on product characteristics. Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.

1.04 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the scheduled fire ratings when tested in accordance with methods indicated and ASTM E 814, UL 1479 or UL 2079 .

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   a. Comply with any different or additional requirements set by the Authority Having Jurisdiction.

1.05 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

C. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING, GENERAL

A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacture based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacture and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. The Design Team has indicated detailing to be the basis of firestopping systems to be submitted. Not every condition is covered. Additional conditions requiring firestopping systems will be encountered during the Contractors' coordination and construction. UL or other tested assemblies have been included on the drawings. Engineering judgements by a manufacturer may also be represented on the drawings. This information is provided to set the design intent for the final systems to be submitted and installed.

2.03 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 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.

3.04 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.

3.05 PROTECTION

A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

3.06 INSPECTION AND MAINTENANCE

A. Upon building completion, any code required maintenance and annual inspection of firestopping shall fall on the building owner.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sealants.

B. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestopping sealants.

B. Section 07 9216 - Interior Floor Joint Filler and Sealant

C. Section 08 8000 - Glazing: Glazing sealants and accessories.

D. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants.

D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

E. SCAQMD 1168 - Adhesive and Sealant Applications.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. 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.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01 6116.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a 2 year period after Date of Substantial Completion.

C. 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

2.01 MANUFACTURERS

A. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.

B. Dow Corning Corporation: www.dowcorning.com/construction/sle.

C. Pecora Corporation: www.pecora.com.

D. Tremco Global Sealants: www.tremcosealants.com.

E. Sika Corporation: www.usa-sika.com.

F. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

G. W.R. Meadows, Inc: www.wrmeadows.com/sle.

H. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SEALANTS

A. Exterior Portland cement concrete pavement joint sealant, non-sag silicone, ASTM D5893 Type NS, single component, low modulus, weather and UV resistant.
   1. Color: Gray
   2. Product:
      a. Dow Corning #888
   3. Movement Capability: Plus 100 percent, minus 50 percent.
   4. Appplications: Use for sealing of cracks and joints in exterior concrete paving.

B. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
   1. Product:
      a. Pecora: BC-158.
      b. Tremco: TremPro JS-773.
   2. Applications: Use for:
      a. Concealed sealant bead in sheet metal work.

C. General Purpose Interior Sealant: Siliconized acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
   1. Color: Standard colors matching finished surfaces.
   2. Product:
      a. Pecora: AC-20 + Silicone.
      b. BASF: MasterSeal NP 520.
      c. Tremco: Tremflex 834
   3. Applications: Use for:
      a. Interior wall and ceiling control joints.
      b. Joints between door and window frames and wall surfaces.
      c. Other interior joints for which no other type of sealant is indicated.

D. Bathtub/Tile Sealant: Silicone; ASTM C 920, Uses I, M and A; single component, mildew resistant.
   1. Product:
      a. Pecora: #898.
      b. BASF: OmniPlus.
      c. Tremco: Tremsil 200
   2. Applications: Use for:
      a. Joints between plumbing fixtures and floor and wall surfaces.
      b. Joints between kitchen and bath countertops and wall surfaces.

E. Nonsag Polyurethane Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A, G; multi component, chemical curing, non-staining, non bleeding, non-sagging type.
   1. Color: Colors as selected by Architect from manufacturer's standard stock color selection.
   2. Product:
      a. Pecora: Dynatrol II.

b. Tremco Dymeric: 240FC.
c. BASF MasterSeal NP2.
d. Sikaflex-2c NS
3. Movement Capability: Plus and minus 25 percent.
4. Applications:
a. interior joints between concrete wall panels and between concrete panels and other work.

F. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Class 25 minimum; Uses T, I, M, A, O; single component, chemical curing, non staining, non bleeding, capable of continuous water immersion, self-leveling type.
1. Color: Gray.
2. Product:
a. Pecora: Urexpan NR 201.
b. BASF MasterSeal SL1.
c. Tremco: 45SSL.
d. Sikaflex-1c SL.
3. Movement Capability: Plus and minus 50 percent.
4. Applications:
a. Joints in sidewalks and exterior concrete paving
b. Joint where concrete sidewalk or paving abuts vertical surfaces.

G. Silicone Sealant: ASTM C 920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, moisture curing, non staining, non bleeding.
1. Color: Color as selected by Architect from manufacturer's standard stock color selection.
2. Product:
a. Dow Corning: #790.
b. Pecora: #890.
c. Tremco: Spectrem 1.
3. Movement Capability: Plus 100 percent, minus 50 percent.
4. Applications:
a. Exterior and interior perimeter joints at storefronts.
b. Bedding joints under exterior thresholds.
c. Exterior joints between concrete wall panels and between concrete panels and other work.

2.03 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.

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. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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. 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.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Employ installation techniques which will insure that caulking materials are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and debris.

G. Do not allow materials to overflow or spill onto adjacent surfaces. use masking tape or other precautionary devices to prevent staining of adjacent surfaces.

H. Remove excess and misplaced materials as work progresses. Clean the adjoining surfaces to eliminate evidence of misplaced materials, without damage to adjacent surfaces or finishes.

I. Tool joints concave.

J. 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.

K. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 EXTERIOR CONCRETE WALL PANEL JOINTS

A. Coordinate installation of sealant and backer rod material with installation of textured coating. Backer rod may be placed in joint to prevent textured coating from adhering to joint surfaces.

B. Install backer rod half way into joint prior to coating panels; remove backer rod and rotate 180 degrees and reinsert prior to installing sealant.

C. Install panel joint sealant after textured coating has been applied.

3.05 CLEANING

A. Clean adjacent soiled surfaces.

3.06 PROTECTION

A. Protect sealants until cured.

END OF SECTION

SECTION 07 9216
INTERIOR FLOOR JOINT FILLER AND SEALANT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installing floor joint filler in construction joints and sawn contraction joints, plus floor joint sealant in isolation joints, in interior concrete floor slabs within Warehouse Area.

1.02 RELATED SECTIONS

A. Section 03 3000 - Cast-In-Place Concrete.

B. Section 07 9200 - Joint Sealants

1.03 REFERENCES

A. A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ASTM D 2240 - Rubber Property - Durometer Hardness.
   2. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

1.04 SUBMITTALS

A. Product Data: Provide data indicating filler and sealant performance criteria, substrate preparation, limitations and color availability.

B. Color Samples: Submit samples of manufacturer's standard material colors and special colors as indicated at least 30 days prior to commencement of application. Samples shall be actual materials.

C. Submit manufacturer's approved applicator certificate.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver and store materials in manufacturer's unopened packaging with seals and labels intact. Comply with manufacturer's instructions regarding environmental conditions under which materials may be stored.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the joint filler and sealant manufacturer during and after installation.

B. Comply with manufacturer's recommendation as to environmental conditions under which materials may be applied.

PART 2 PRODUCTS

2.01 SEMI-RIGID JOINT FILLER

A. Epoxy Products:
   1. Metzger/McGuire Co: MM-80.
   2. Euclid Chemical Co - Euco 700.
   3. Substitutions: Not permitted.

B. Polyurea Products:
   1. Metzger/McGuire Co: EdgePro EP-90.
   2. Substitutions: Not permitted.

C. Description:
   1. Hardness Shore A: A85 minimum.
   2. Tensile Strength: 500 psi minimum.
   3. Adhesion to Concrete: 285 psi minimum.
   4. Solids Content: 100%.

5. Color: As selected by architect to match surrounding concrete.

D. Joint Filler Stain Preventing Film:
1. SPF by Metzger/McGuire.
2. Euco CleanCut by Euclid.
3. Substitutions: Not permitted.

2.02 SELF-LEVELING FLEXIBLE POLYURETHANE ISOLATION JOINT SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:
1. Pecora: Dynaflex.
2. BASF: MasterSeal SL 2.
3. Tremco: THC 901.
4. Substitutions: Not permitted.

B. Description:
1. Hardness - Shore "A": A30 minimum.
2. Movement Capability: Plus and minus 25 percent.
3. Color: As selected by architect to match surrounding concrete.

2.03 ACCESSORIES

A. Do not use silica sand to choke-off shrinkage cracks beneath filler.

B. The use of compressible foam backer rod is strictly prohibited in ALL saw-cut contraction joints. Use of backer rod in any saw-cut joints will result in rejection of all saw-cut joint work.

C. Compressible foam backer rod may be used in through slab construction joints only but MUST be placed below saw-cut shelf and at a minimum depth of 2 inch. No other use of backer rod will be allowed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be by installer who is approved in writing by the manufacturer's corporate office for this project. It is the responsibility of the installer to inspect project and joint conditions and notify on-site management in writing of any deficiencies that might adversely affect the quality or durability of the work performed or the contract price. Start of work by the installer implies acceptance of conditions.

B. Installation shall not proceed until the slab has aged a minimum of 90 days.

C. Use joint filler stain preventing film at all joints where semi-rigid epoxy joint filler is applied.

3.02 JOINT SURFACE PREPARATION

A. Prior to installation of joint fillers, all saw-cut joints shall be thoroughly cleaned to their full original depth. Construction joints shall be cleaned to a minimum depth of 2 inch.

B. Construction joints shall be recut minimum 1/8 inch wide by 2 inch deep.

C. Where joints have minor raveling and edge chips (less than 1 inch wide), they shall be squared off and filled along with the joint itself.

D. Wide area surface spalled areas along the joint (1 inch wide and greater) shall be squared off and filled with epoxy repair mortar and joint recut and filled as per Section 03 3560 - Concrete Floor Finishing.

E. Apply stain preventing film prior to joint cleanout and filler placement.

3.03 CHOKING-OFF JOINT BOTTOM

A. Do NOT use silica sand placed at the bottom of the saw-cut joints to prevent filler run-thru into the shrinkage crack.

B. Compressible backer rod is prohibited in saw-cut joints.

C. Compressible backer rod may be used in through-slab (non-sawn) construction joints only, but must be placed BELOW saw-cut shelf and at a miniumum depth of 2”. No other use of backer rod will be allowed.

3.04 APPLICATION OF SEMI-RIGID JOINT FILLER

A. Material shall be mixed and installed in strict accordance with manufacturer's printed installation instructions, except where more stringent requirements are shown or specified.

B. Install using a two pass method per manufacturer instructions, with second pass overfilled (crowned).

C. Once the filler has fully cured, razor off excess to leave a flush filler profile. The overfill should be heated just prior to shaving to provide a smooth, flush filler profile (see manufacturer instructions on heating methods).

D. Remove stain preventing film. Film shall be removed by joint filler installer immediately after shaving joint filler.

3.05 APPLICATION OF FLEXIBLE POLYURETHANE JOINT FILLER

A. Material shall be mixed and installed in strict accordance with manufacturer's printed installation instructions, except where more stringent requirements are shown or specified.

B. Joint surfaces shall be primed as required by manufacturer to insure bonding.

C. Provide backer rod in joint at a uniform depth of 1/2 the joint width, with a minimum depth of 1/4 inch and a maximum depth of 1/2 inch. Take all necessary steps to prevent three sided adhesion.

D. Final cured profile shall be flush with the floor surface.

3.06 JOINT FILLER DEFICIENCIES

A. Installer is advised that significant deficiencies in workmanship, including less than proper filler depth, inadequate joint cleaning, concave filler profile, etc., shall be removed and properly replaced.

B. Joint filler installed to depths less than specified in this Section shall be removed and replaced at no additional cost to the General Contractor (GC) or Owner, and without extending project completion date. As each sector of work is completed the GC, using a 1/8” drill bit, shall drill through the filler to verify filler depth. GC shall test drill at an approximate rate of 1 core every 1,000 lineal feet. Location of core and filler depth measured shall be recorded and provided to the owner prior to project completion.

3.07 JOINT FILLER SEPARATION:

A. Joint filler separation, both adhesive (leap-frog side to side) and cohesive, occurs as a result of concrete shrinkage and subsequent joint opening in excess of the fillers ability to laterally expand. In the event joint separation voids are 0.03. inch (credit card width) or greater, correction by refilling shall be required.

3.08 JOINT SEALANT INSTALLATION

A. Conform to manufacturer's printed installation instructions.

3.09 JOINT FILLER SCHEDULE LOCATIONS

A. Interior Floor Slab Isolation Joints Subject to Movement: Flexible polyurethane joint sealant.
   1. Interior floor slab joints subject to movement include joints between floor slab and column isolation placements, and floor slab isolated from vertical wall surface.

B. Interior Warehouse Floor Slab Joints: Semi-rigid epoxy or polyurea joint filler.
   1. Interior floor slab joints in non-office areas of Warehouse not subject to movement include sawn contraction joints and construction joints.

END OF SECTION

SECTION 07 9513
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies at floor to floor conditions of suspended slabs.

1.02 RELATED REQUIREMENTS

A. Section 07 9514 - Expansion Joint Systems: Expansion joint systems in walls, floors and ceilings utilizing preformed compressible assemblies, aluminum, and aluminum and flexible materials.,

B. Section 07 8400 - Firestopping: Additional fire rated assemblies.

1.03 REFERENCE STANDARDS

A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
   3. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
   4. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
   5. ITS (DIR) - Directory of Listed Products.
   6. UL (DIR) - Online Certifications Directory.
   7. ASTM SA240 or ASTM A276 Type 304 - Standard Specification for Stainless Steel Bars and Shapes.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.

C. Product Data: Non-shrink epoxy grout for setting floor flanges.

D. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, transitions. Submit the entire coordinated system.

E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.05 QUALITY ASSURANCE

A. Field Measurements: Verify compliance with manufacturer's requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Expansion Joint Cover Assemblies:
   1. Watson Bowman Acme: www.wbacorp.com, Basis of design.
      a. Contact:
         Jay Mroz
         (716) 860-6597
         jay.mroz@watsonbowmanacme.com
   2. Balco - A CSW Industrials Company; www.balcousa.com
      a. Contact:
         Tammy Goss
         (316) 425-0740 direct
         (800) 767-0082 ext 340

tammy.goss@balcousa.com

3. Substitutions for other manufacturers: Not permitted.

B. Products; Pre-appproved model numbers by Tenant:
   1. Interior Floor-to-Floor:
      a. Watson Bowman Acme; AMZFNB-200, AMZFNB-300, AMZFNB-400, AMZ FNB-500, AMZFNB-600, AMZFNB-700, AMZFNB-800, AMZFNB-900, AMZFNB-1000, AMZFNB-1200
      b. Balco; NBAF-2, NBAF-2.5-5, NBSF-1.5-3-AM1, NBSF-1.5-3-AM2, NBSF-2, NBSF-2-4-AM1, NBSF-2-4-AM2, NBSF-2.5-5, NBSF-3-6-AM1, NBSF-4-8-AM1
   2. Fire Barrier System - Floor: As required by manufacturer for indicated rated assemblies.
      a. Watson Bowman Acme; Wabo FireFlex
      b. Balco; Metaflex 5000 or Metaflex Pro depending on joint width
   3. Transitions: Same manufacturer and series as joint cover.
   4. Substitutions: Not permitted for interior floor-to-floor assemblies.

2.02 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, fire rated assemblies.

B. Joint covers shall permit unrestrained movement of joint without disengagement of cover
   1. Joint Dimensions and Configurations: As indicated on drawings. Confirm requirements with structural documents.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

C. 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).

2.03 MATERIALS

A. Aluminum:
   1. ASTM B221, alloy 6063-T5 for extrusions.
   2. ASTM B209, alloy 6061-T6 for plate.
   3. ASTM B209, alloy 5052-H32 for sheet.

B. Stainless Steel:
   1. ASTM A276 Type 304 for cover plates, minimum thickness 3/16 inch.

C. Anchors and Fasteners: As recommended by cover manufacturer.

D. Non-shrink epoxy grout for setting floor flanges, equal to:
   1. Watson Bowman Acme; MBS Masterseal 350
   2. Balco; W. R Meadows Rezi-Weld 3/2

2.04 FINISHES

A. 36 grit brushed finish exposed surface for cover plate.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.
C. Rigidly anchor to substrate to prevent misalignment.
D. Refer to structural drawings for recommended joint installlation process.
E. Refer to architectural drawings for final fire rated joint assembly.

3.03 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

SECTION 07 9514
EXPANSION JOINT SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint systems for interior and exterior, wall, floor and ceiling conditions.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Roof expansion and control joint covers.

B. Section 07 9200 - Joint Sealants - Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.

C. Section 07 9513 - Expansion Joint Cover Assemblies: Expansion joint cover assemblies for suspended floor slabs.

D. Section 09 2116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

E. Section 07 8400 - Firestopping: Additional fire rated assemblies.

1.03 REFERENCE STANDARDS

A. Referenced standards are to be the latest editions adopted at project bid date.
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
   3. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
   4. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.
   5. ITS (DIR) - Directory of Listed Products.
   6. UL (DIR) - Online Certifications Directory.
   7. ASTM SA240 or ASTM A276 Type 304 - Standard Specification for Stainless Steel Bars and Shapes.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.

C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, transitions. Submit the entire coordinated system.

D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.05 QUALITY ASSURANCE

A. Field Measurements: Verify compliance with manufacturer's requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Expansion Joint Systems:
   1. Balco Inc.; www.balcousa.com
   2. Watson Bowman Acme (WABO): www.wbacorp.com
   3. Substitutions for other assemblies: See Section 01 6000 - Product Requirements.

B. Products: WABO - Basis of Design:
   1. Exterior Wall-to-Wall:
      a. Balco FCWW series

b. WABO WeatherSeam
2. Exterior Ceiling:
   a. Balco FCWW series
   b. WABO WeatherSeam
3. Interior Floor-to-Wall:
   a. Balco WD series (up to 4 inch joints)
   b. WABO FastWall
4. Interior Wall-to-Wall: WABO FastWall
   a. Balco WD series (up to 4 inch joints)
   b. WABO FastWall
5. Interior Wall and Ceiling:
   a. Balco 75FCA for acoustical ceiling or 75FWG for drywall
   b. WABO CorridorWrap WC
6. Interior Slab-to-Slab and Slab-to-Wall: WABO FireShield FSH
   a. Balco 2FRBCS series
   b. WABO FireShield FSH
7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXPANSION JOINT SYSTEMS

A. Systems as indicated on drawings, or as required to complete closure of expansion joints.

B. Expansion Joint Systems - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected, fire rated and non-rated assemblies.

C. Joint covers shall permit unrestrained movement of joint without disengagement of cover
   1. Joint Dimensions and Configurations: As indicated on drawings. Confirm requirements with structural documents.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Refer to drawings for correct application of wall-to-wall, wall-to-corner, floor-to-wall, wall-to-ceiling, ceiling-to-ceiling conditions.
   4. Expansion joint material shall be suitable for expansion joint size as shown on drawings.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

D. Covers In Fire Rated Assemblies: Provide systems having fire rating equivalent to that of assembly into which it is installed.
   1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

2.03 MATERIALS

A. Aluminum:
   1. ASTM B221, alloy 6063-T5 for extrusions.
   2. ASTM B209, alloy 6061-T6 for plate.
   3. ASTM B209, alloy 5052-H32 for sheet.

B. Stainless Steel:
   1. ASTM A276 Type 304 for cover plates.

C. Preformed flexible seal:
   1. Silicone face with acrylic infused open-cell polyurethanefoam.

D. Resilient Seals:
   1. For Exterior Walls and Ceilings: Outer visual seal and inner functional seal, manufacturer's standard materials; EPDM rubber, Neoprene, or Santoprene.
   2. For Interior Walls and Ceilings: Outer visual seal elastomeric seal, inner rated seal as required for fire rating, manufacturer's standard materials; EPDM rubber, Neoprene, or Santoprene, PVC.
   3. Color: As selected.

E. Anchors and Fasteners: As recommended by cover manufacturer.

2.04 FINISHES

A. Mill finish for metals, unless otherwise noted for specific product.

B. Color as selected from manufacturers' standard for prefinished.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Thermally insulated hollow metal doors with frames.

D. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - DOOR HARDWARE.

B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.

C. Section 09 9113 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

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

B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

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

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.

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.

H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities.

J. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute (ANSI/DHI A115 Series).

K. ITS (DIR) - Directory of Listed Products.

L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.

M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.

N. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames.

O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

S. SD! - 105 - Recommended Erection Instructions for Steel Frames.

T. UL (BMD) - Building Materials Directory.

U. UL (DIR) - Online Certifications Directory.

V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Curries Co.: www.curries.com
   2. Steelcraft, an Allegion brand: www.allegion.com/us.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESIGN CRITERIA

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
   4. Typical Door Face Sheets: Flush.
   5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
   6. 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.
   7. Finish: Factory primed, for field finishing.

B. 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.

2.03 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18 gage). No visible seams permitted.
   2. Core: Polystyrene foam.
   3. Door Thickness: 1-3/4 inch, nominal.
   4. Top Caps : Flush with top of faces and edges.
   5. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.

6. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363 .
7. Weatherstripping: Refer to Section 08 7100.
8. Wind Load Design: 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 speed: Design Wind Speed: See Structural Drawings.

B. Interior Doors, Non-Fire Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18 gage). No visible seams permitted.
2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inch, nominal.

C. Fire-Rated Doors:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 2, seamless (18 gage). No visible seams permitted.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   a. Attach fire rating label to each fire rated unit.
3. Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inch, nominal.
5. Thickness: 1-3/4 inches.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. General:
1. Comply with the requirements of grade specified for corresponding door.
   a. ANSI A250.8 Level 2 Doors: 16 gage frames.
2. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

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. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire-Rated: Fully welded type.

E. Interior Door Frames, Fire-Rated: Fully welded type.
1. Fire Rating: Same as door, labeled.

F. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.

B. Glazing: As specified in Section 08 8000, factory installed.

C. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

D. Astragals for Double Doors: Specified in Section 08 7100.
1. Exterior Doors: Steel, Z-shaped.

E. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.06 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install frames in accordance with SDI-105

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 08 7100.

F. Comply with glazing installation requirements of Section 08 8000.

G. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING AND CLEANING

A. Adjust for smooth and balanced door movement.

B. Fill all dents, holes, etc. with metal filler and sand smooth and flush with adjacent surfaces - Paint to match finish.

C. Remove dirt and excess sealants, mortar, or glazing compounds from exposed surfaces.

END OF SECTION

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, and acoustical.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - HOLLOW METAL DOORS AND FRAMES.

B. Section 08 7100 - DOOR HARDWARE.

C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1.

C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Specimen warranty.

E. Samples: Submit two samples of door veneer, 3 x3 inch in size illustrating wood grain, stain color, and sheen.

F. Furnish letter documenting that composite wood products do not contain added urea-formaldehyde binder or resins.

G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.06 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. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Graham Wood Doors: www.grahamdoors.com.
   2. Eggers Industries: www.eggersindustries.com.
   3. Marshfield DoorSystems, Inc: www.marshfielddoors.com.
   4. Algoma Hardwoods, Inc.: www.algomahardwoods.com

2.02 DOORS

A. Doors: Refer to drawings for locations and additional requirements.
   1. Quality Level: Custom Grade, Standard Duty performance, in accordance with AWI/AWMAC/WI (AWS).
   2. Wood Veneer Faced Doors: 5-ply or 7-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at all locations.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Wood veneer facing with factory transparent finish as indicated on drawings.

2.03 DOOR AND PANEL 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.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Maple, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Compatible hardwood.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 ACCESSORIES

A. Glazing: As specified in Section 08 8000.

B. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style nails.

C. Astragals for Double Doors: Steel, T shaped, overlapping and recessed at face edge.

2.06 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.

D. Fit door edge trim to edge of stiles after applying veneer facing.

E. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

F. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

G. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

H. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

A. 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 - 11, Polyurethane, Catalyzed.
      b. Stain: As selected by Architect.
      c. Sheen: Satin - medium rubbed effect.

B. Factory finish doors in accordance with reviewed submittal.

PART 3 EXECUTION

3.01 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.

3.02 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. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).

D. Use machine tools to cut or drill for hardware.

E. Coordinate installation of doors with installation of frames and hardware.

F. Coordinate installation of glazing.

3.03 TOLERANCES

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall access door and frame units.

B. Ceiling access door and frame units.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Field paint finish.

B. Division 22: Plumbing Work.

C. Division 23: Mechanical Work.

D. Division 26: Electrical Work.

1.03 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

PART 2 PRODUCTS

2.01 WALL AND CEILING MOUNTED UNITS

A. Manufacturers:
   1. ACUDOR Products Inc: www.acudor.com/#sle.
   2. Babcock-Davis: www.babcockdavis.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
   1. Material: Steel.
   2. Style: Exposed frame with door surface flush with frame surface.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Door panels: 14 gage, 0.0747 inch single thickness steel sheet.
   5. Frames: 16 gage, 0.0598 inch, minimum thickness.
   6. Steel Finish: Primed.
   7. Sizes:
      a. Walls: 12 x 12 inches.
      b. Ceilings: 12 x 12 inches.
   8. Hardware:
      a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
      b. Latch/Lock: Screw driver slot for quarter turn cam latch.
   9. Prime coat with alkyd primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 3323
OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead coiling doors and shutters, operating hardware, fire-rated and non-fire-rated, interior and exterior, manual and electric operation.

1.02 RELATED REQUIREMENTS

A. Section 08360 - Sectional Overhead Doors.

B. Division 26 - Electrical: Equipment wiring; power to disconnect.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

D. ITS (DIR) - Directory of Listed Products.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NEMA MG 1 - Motors and Generators.

G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

H. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide general construction, electrical equipment, and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Doors:
   1. Clopay Building Products: www.clopaydoor.com/sle.
   2. Cornell Iron Works, Inc: www.cornelliron.com.
   3. Entrematic: www.amarr.com/commercial/sle.
   4. The Cookson Company; www.cooksondoor.com.
   5. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
   6. Overhead Door Company: www.overheaddoor.com
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COILING DOORS

A. Exterior Insulated Coiling Doors:
   1. Capable of withstanding positive and negative wind loads, including pressure equal to 1.5 times the design pressures without undue deflection or damage to components.
      a. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
   2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 7.7.

3. Profile: Flat.
4. Material: Steel
   a. Inner: 22 gauge galvanized
   b. Outer: 22 gauge galvanized
5. Finish: Factory powder coated, color as selected by the Architect.
6. Guides: Galvanized steel
7. Brackets: Galvanized steel
8. Bottom Bar: Two galvanized steel angles
9. Weatherseals: Air infiltration package to meet C402.4.3, air leakage <1.00 cfm/ft2
10. Hood Enclosure: 24 gauge galvanized steel
11. Manual Operation: Chain hoist
12. Mounting: as shown on drawings
13. Acceptable Manufacturers/Models:
    a. Basis of Design - Overhead Door Company: Model 625 Series
    b. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire-Rated Coiling Doors: Steel slat curtain; conform to NFPA 80.
1. Fire rating as indicated on drawings to provide wall assembly rating.
2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for the purpose specified and indicated.
3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
4. Single thickness slats.
5. Profile: Flat.
6. Material: Steel, 24 gauge galvanized
7. Nominal Slat Size: 2 inches wide by required length.
8. Finish: Factory powder coated, color as selected by the Architect.
9. Guides: Powder coated steel
10. Brackets: Powder coated steel
11. Bottom Bar: Two Powder coated steel angles
12. Hood Enclosure: Powder coated galvanized steel
13. Release Mechanism: Automatic closure shall be activated by fusible link and a central smoke/fire alarm system by means of a fail-safe releasing device.
    a. Doors shall maintain an average closing speed of not more than 9 inches per second during normal and automatic closing.
    b. Resetting of spring tension or mechanical dropouts shall not be required.
14. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system.
15. Manual hand crank lift operation.
16. Mounting: As indicated.
17. Locking Devices: Slide bolt on inside.
18. Acceptable Manufacturers/Models:
    a. Basis of Design - Overhead Door Company: Model 631 Series with Fire Sentinel Time-Delay Release; Model FSBX120V120.
    b. Substitutions: See Section 01 6000 - Product Requirements.

C. Fire-Rated Coiling Counter Doors: Steel slat curtain; conform to NFPA 80.
1. Fire rating as indicated on drawings to provide wall assembly rating.
2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for the purpose specified and indicated.
3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
4. Single thickness slats.
5. Profile: Flat.
6. Material: Steel, 24 gauge galvanized
7. Nominal Slat Size: 2 inches wide by required length.

8. Finish: Factory powder coated, color as selected by the Architect.
9. Guides: Powder coated steel
10. Brackets: Powder coated steel
11. Bottom Bar: Two Powder coated steel angles
12. Hood Enclosure: Powder coated galvanized steel
13. Release Mechanism: Automatic closure shall be activated by fusible link and a central smoke/fire alarm system by means of a fail-safe releasing device.
    a. Doors shall maintain an average closing speed of not more than 9 inches per second during normal and automatic closing.
    b. Resetting of spring tension or mechanical dropouts shall not be required.
14. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system.
15. Manual push up operation.
16. Mounting: As indicated.
17. Locking Devices: Slide bolt on inside.
18. Acceptable Manufacturers/Models:
    a. Basis of Design - Overhead Door Company: Model 640 Series with Fire Sentinel Time-Delay Release; Model FSBX120V120.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MATERIALS

A. Curtain Construction: Interlocking 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.
   3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

B. Steel Guides: ASTM A36/A36M steel angles, size as indicated, hot-dip galvanized per ASTM A123/A123M.

C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

D. Lock Hardware:
   1. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
   2. Slide Bolt: Provide on both-jamb sides, extending into slot in guides, with padlock on one side.

E. Roller Shaft Counterbalance: Steel pipe and helical 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install fire-rated doors in accordance with NFPA 80.

C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

F. Complete wiring from fire alarm system.

3.03 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.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION

SECTION 08 3613
SECTIONAL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Overhead sectional insulated doors, manually and electrically operated.

B. Operating hardware and supports.

C. Electrical controls.

1.02 REFERENCE STANDARDS

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

B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

C. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

1.03 SUBMITTALS

A. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.

B. Wind Load Certification: Submit documentation from manufacturer certifying that doors have been tested in accordance with the specified requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.

B. Doors shall include a manufacturer's label certifying compliance with specified windload.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for warranty requirements.

B. Provide one (1) year warranty against defects in materials and workmanship, commencing with the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 INSULATED STEEL SECTIONAL DOORS

A. Acceptable Manufacturers:
   1. Basis of Design - Overhead Door Co: www.overheaddoor.com: Thermacore 591 Series
   2. Kelley Entrematic: www.kelleyentrematic.com: Series 2742.
   3. Clopay: www.clopay.com : Model 3717
   4. Substitutions: See Section 01600 - Product Requirements.

B. Characteristics:
   1. Size: As indicated on the drawings.
   2. Type: Metal/foam/metal sandwich panel construction, with EPDM thermal break and ship-lap design with rounded water channels.
   3. Panels:
      a. Metal Facer: Nominal .015 inch galvanized steel, stucco embossed.
      b. Panel Thickness: nominal 1 5/8 inch.
      c. Finish: Manufacturer’s standard baked-on polyester coat. Color to be white.
      d. Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
      e. Thermal Values: Minimum R-value of 14.6.
   4. Operation:
      a. Truck Doors: Manual pull rope operated, mounted left side of door.
      b. Drive-In Doors: Electric motor operated.
   5. Lift: Full vertical, unless otherwise indicated.

6. Hardware:
   a. Counterbalance: Heavy duty torsion springs mounted on cross header shaft. Minimum 25,000 cycle.
   b. Tracks: 3 inch.
   c. Provide lift handles on inside face.
   d. Lock: Provide inside only slide bar lock – mount at 5 feet AFF on left side of door.
   e. Hinges: heavy duty.
   f. Provide spring bumpers.
   g. Steel step plate, inside bottom left.
7. Weatherstripping: EPDM rubber tube seals fitted inside joints between sections. EPDM rubber bulb-type strip at bottom. Header seal and jamb weatherstripping.
8. Vision Panel: Nominal size 24 inch x 6 inch, insulated, either double strength glass or acrylic. Frame to match door finish.
9. Wind Load Design: Withstand positive and negative wind loads when tested in accordance with ASTM E 330. Total test duration for each test direction shall be one minute at design pressure. Include pressure equal to 1.5 times the design pressure for 10 seconds during each test.
   a. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.

2.02 ELECTRICAL OPERATION

A. Electrical Characteristics:
   1. 1/2 hp; 30 rated load amperes; manually operable in case of power failure, transit speed of 12 inches per second.
   2. 480 volts, three phase, 60 Hz.

B. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.

C. Safety Edge: At bottom of door panel, full width; pneumatic sensitized type, wired to stop door upon striking object; hollow neoprene covered to provide weatherstrip seal.

D. Control Station: 7-pin Interchangeable cylinder, key-operated (on/off) lockout type control for each electric operator.
   1. to be connected at controller, single gang NEMA 1 box
   2. 24 volt circuit.
   3. Surface mounted.
   4. Locate at inside door jamb, side with window

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

B. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.

B. Anchor assembly to wall construction and building framing without distortion or stress.

C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.

D. Fit and align door assembly including hardware.

E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.

B. Maximum Variation from Level: 1/16 inch.

C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.

D. Maintain dimensional tolerances and alignment with adjacent work.

3.04 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

B. Clean doors, frames and glazing.

C. Remove temporary labels and visible markings.

D. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Weatherstripping.

D. Door hardware.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Steel attachment devices.

B. Section 361 - Joint Sealers: Perimeter sealant and back-up materials.

C. Section 08 5113 - Aluminum Windows: Operable sash system.

D. Section 08 7100 - DOOR HARDWARE: Hardware items other than specified in this section.

E. Section 08 8000 - Glazing: Glass and glazing accessories. Coordination of energy code compliance.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

G. 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.

H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

K. NFRC - North American Fenestration Council: Energy Code compliance. Component Modeling Approach (CMA).

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

F. Certificates: Certify that assemblies meet or exceed specified requirements.

1.05 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.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 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.

1.07 PROJECT CONDITIONS

A. Coordinate the work with installation of vapor retarder components or materials.

1.08 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.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum-Framed Storefront and Doors:
   1. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com/sle.
   2. EFCO Corporation: www.efcocorp.com.
   3. Kawneer North America; Trifab VG 451T - Basis of Design: www.kawneer.com.
   4. Tubelite, Inc: www.tubeliteinc.com.
   5. United States Aluminum Corp: www.usalum.com.
   6. YKK AP America Inc: www.ykkap.com.

2.02 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Position: Centered (front to back).
   2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
   3. Finish: Class I color anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   4. 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.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   6. 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.

7. 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.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

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: See Structural Drawings for Component and Cladding, Service Loads.
   b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 10 psf.
3. Air Leakage: 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. Provide steel reinforcement in mullions as required to meet wind load.
5. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
6. 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.
7. 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.
8. Exterior Assemblies Energy Ratings: Label units with doucumentation that full assembly meets NFRC standards as described for this design including U-factor, solar heat gain coefficient, air leakage and visible transmittance.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. Doors: Glazed aluminum, wide stile.
1. Thickness: 1-3/4 inches.
2. Top Rail: 5 inches wide.
3. Vertical Stiles: 5 inches wide.
4. Bottom Rail: 10 inches wide.
5. Glazing Stops: Square.
6. Finish: Same as storefront.

C. Sill Pan Flashing:
1. High-Performance (HP) sill pan. Equal to Trifab 451 HP by Kawneer Company.

D. Operable Sash: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.

2. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
3. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
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. Air Infiltration: Limit air infiltration through assembly to 0.3 cu ft/min/sq ft of wall area, measured at a specified differential pressure across assembly in accordance with ASTM E283.
6. Water Infiltration Test Pressure Differential: 8 pounds per square foot.
7. Horizontal Sliding Type:
   a. Construction: Thermally broken.
   b. Glazing: As specified in Section 08 8000.
   c. Exterior Finish: Class I natural anodized.
   d. Interior Finish: Class I natural anodized.
   e. Color: Dark bronze.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel. Exposed fasteners, countersunk, finish to match aluminum color.

D. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.

E. Concealed Flashings: 0.018 inch thick galvanized steel.

F. Perimeter Sealant: Type - Silicone, specified in Section 361.

G. Glass: As specified in Section 440.

H. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

B. Color: Dark bronze.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE

A. Door Hardware as indicated on Drawings.

2.07 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce components internally for door hardware .

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 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.

3.02 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. Coordinate attachment and seal of perimeter air and vapor barrier materials.

I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

J. Set thresholds in bed of sealant and secure.

K. Install hardware using templates provided.

L. Install glass in accordance with Section 08 8000, using glazing method required to achieve performance criteria.

M. Install perimeter sealant in accordance with Section 361.

N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

A. Adjust operating hardware for smooth operation.

3.05 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. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 4313 - Aluminum-Framed Storefronts: Entrance framing and doors as component in curtainwall framing system.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.

B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

G. 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.

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glazing 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.

1. Include design engineer's signature and stamp or seal on shop drawings for attachments and anchors.

D. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 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 at the State in which the Project is located.

1.06 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.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

C. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. YKK AP America Inc: www.ykkap.com.
   2. Kawneer North America; Product 1600: Basis of Design www.kawneer.com.
   3. United States Aluminum Corp: www.usalum.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: 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.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
      c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; 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.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with requirements of the requirements of ASCE 7.
      a. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
   2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Performance Requirements: No uncontrolled water on indoor face when tested as follows:
   1. Test Method: ASTM E331.
   2. Test Pressure Differential: 2.86 lbf/sq ft.

D. Air Leakage: 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.

E. Air Infiltration Performance Requirements:
   1. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area or less, measured in accordance with ASTM E283.
   2. Air Infiltration Test Pressure Differential: 6.24 pounds per square inch.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
   1. Cross-Section: Nominal 2-1/2 x 7-3/4 inch nominal dimension.
   2. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: As specified in Section 08 8000.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; shop primed.

C. Fasteners: Stainless steel.

D. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.

E. Concealed Flashings: 0.018 inch thick galvanized steel.

F. Perimeter Sealant: Silicone, as specified in Section 07 9200 - Joint Sealants.

G. Glazing: As specified in Section 08 8000 - Glazing.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

I. Glazing Accessories: As specified in Section 08 8000.

J. Thermal Barrier: Thermal separation shall be extruded of a silicone compatible elastomer that provides a minimum 1/4 inch separation.

2.05 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating or AAMA 612 electrolytically deposited colored anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.

B. Color: Dark bronze.

PART 3 EXECUTION

3.01 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.

C. Verify that anchorage devices have been properly installed and located.

3.02 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. Coordinate attachment and seal of perimeter air and vapor barrier materials.

H. Pressure Plate Framing: Install glazing in accordance with Section 08 8000, using exterior dry glazing method.

I. Install perimeter sealant in accordance with Section 07 9005.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 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. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

3.05 PROTECTION

A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 5113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum windows with fixed sash and operating sash.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between window frames and adjacent construction.

B. Section 08 4313 - Aluminum-Framed Storefronts: Operable sash within framing system.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site.

B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association.

1.04 PERFORMANCE REQUIREMENTS

A. Design and size windows to withstand the following load requirements, when tested in accordance with ASTM E 330 using test loads equal to 1.5 times the design wind loads with 10 second duration of maximum load:
   1. Design Wind Loads: See Structural Drawings for Component and Cladding, Service Loads.
   2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

B. Air Infiltration: Limit air infiltration through assembly to 0.3 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E 283.

C. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 8.0 lbf/sq ft.

D. Exterior Assemblies Energy Ratings: Label units with doucumentation that full assembly meets NFRC standards as described for this design including U-factor, solar heat gain coefficient, air leakage and visible transmittance.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.

C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, , and installation requirements.

D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 WARRANTY

A. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 EXTERIOR WINDOW MANUFACTURERS

A. Exterior/Guardhouse:
   1. Acceptable Manufacturers:
      a. EFCO, a Pella Company: www.efcocorp.com.
      b. YKK AP America Inc: www.ykkap.com.
      c. Kawneer: 5450 Ultra Thermal Horizontal Slider; www.kawneer.com.
      d. YKK AP America Inc: www.ykkap.com.
      e. US Aluminum
      f. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Manual open, self closing

B. Size and opening: As shown on drawings.

C. Glazing: Maufacturer's standard 1/4 inch clear tempered glass

D. Color: Dark Bronze

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

F. Aluminum auto locks.

G. Maufacturer's standard stainless steel shelf option.

2.03 FABRICATION

A. Fabricate components with smallest possible clearances and shim spacing around perimeter of assembly that will enable window installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Prepare components with internal reinforcement for operating hardware.

F. Provide internal drainage of glazing spaces to exterior through weep holes.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Install sill and sill end angles.

E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.

G. Install perimeter sealant.

END OF SECTION

(TENANT DOCUMENT VERSION 5.1 – APRIL 2021)

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 PROCUREMENT

A. Vendors
   1. Items covered in this section shall be provided and installed by the General Contractor, unless noted otherwise on the drawings.
   2. All items in this section shall be purchased by the general contractor.

1.3 SUMMARY

A. This Section includes commercial door hardware for the following:

   1. Swinging doors.
   2. Sliding doors
   3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Automatic operators.

C. Related Sections:

   1. Division 08 Section “Hollow Metal Doors and Frames”.
   2. Division 08 Section “Flush Wood Doors”.
   3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
   4. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.

3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5 NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.4 Site Verifications – Brownfield Sites

A. Brownfield sites commonly refer to an existing warehouse facility where the tenant is renovating the building to suite their operational needs. Existing exterior door hardware will need to be surveyed and inspected to ensure that it meets tenant's security requirements. Non-compliant hardware will need to be replaced to meet tenant's current specifications. This may entail replacement of existing door / frame assembly, if required to accept the new hardware.
   a. Refer to the drawings for additional information

B. Contractor to visit the existing job site and examine existing Door / Frame / Hardware condition and provide a survey to tenant's representative. Existing doors / frames / hardware to be free of rust and in good working order. Damaged components shall be repaired or replaced.

C. Survey existing lockset(s) or panic devices and verify that all locking hardware will accept 7-pin Small Format Interchangeable Cores (SFIC) core (Refer to Section 087100 2.5). Provide new lockset(s) or panic device(s) to accept proper SFIC core if not already existing.
   1. If existing lockset or panic device within the new warehouse or office areas are required to be replaced, then provide locking hardware based on the following:
      a. For perimeter HM egress doors, refer to hardware set #4.
      b. For perimeter HM trucker's entry doors, refer to hardware set #4B.
      c. For perimeter Storefront egress doors, refer to hardware set #2A
      d. At new Main Entry, Recruiting, or Staffing entry locations, the existing hardware set will need to be compatible with tenant's electronic access control system as well as incorporate panic devices compatible with the small format SFIC core.
   2. All site verifications shall be coordinated by GC to include considerations of existing door and frame preps, fire ratings, windstorm/hurricane ratings, special circumstances, and general construction time line needs.

1.5 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following, if requested:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.7 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modification or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by

representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures.

G. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.8 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.9 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Special Warranty Periods:

1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.11 DEFINITIONS

A. The following is a general list of terms included in the specification that may require additional definitions.

1. “RX” – Request to Exit
2. “EPT” – Electronic Power Transfer
3. “DPS” – Door Position Switch
4. “SFIC” – Small Format Interchangeable Core
5. “ELR” – Electric Latch Retraction
6. “NL” – Night Latch
7. “ELEC” – Electrified
8. “CLSRM” – Classroom

9. “LDW” – Less Door Width

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.
    c. Four Hinges: For doors with heights 91 to 120 inches.
    d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. McKinney Products; ASSA ABBLOY Architectural Door Accessories (MK) – TA Series.

B. Continuous Geared Hinges: ANSI/BHMA A156.26, Grade 1-600, certified continuous geared hinge. With minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suite door height and prepare for electrical cutouts.

1. Manufacturers:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges where scheduled with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Pemco Products; ASSA ABLOY Architectural Door Accessories (PE)-EL-CEPT Series.
    b. Securitron (SU) – EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.

D. Door Cord: Provide surface applied door cord power transfers where scheduled with Molex standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable. 18” cord will be standard unless scheduled otherwise.

1. Manufacturers:

    a. Keedex (KX) – Part No. K-DL38A.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

    a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:

    a. Rockwood Products; ASSA ABLO Architectural Door Accessories (RO)

2.5 CYLINDERS AND KEYING

A. All key structures and final keying/installation of final keying will be purchased and coordinated by tenant directly. For more information contact:

1. DH Pace Security Solutions
   Attn: DH Pace Key Services Center
   PH: 888-643-3667
   1901 E. 119th St.
   Olathe, KS 66061
   amazondoors@dhpace.com

B. Construction Keying: Provide temporary green SFIC keyed cores. Include 2 control keys and 15 operating keys. Installer shall confirm functionality of lock and core as part of installation.

C. All locking devices shall accommodate 7 pin Small Format Interchangeable Cores (SFIC).

D. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary

markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

    a. Lund Equipment (LU).
    b. MMF Industries (MM).
    c. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:

    a. Sargent Manufacturing (SA) – 8200 Series.
    b. No substitution.

B. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.

1. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.

2. Locks are to be non-handed and fully field reversible.

3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.

4. Manufacturers:

    a. Sargent Manufacturing (SA) – 10 Line.
    b. No substitution.

2.7 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Support end-of-line

resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. Manufacturers:

   a. Sargent Manufacturing (SA) – 8200 Series
   b. No substitution.

B. Electromechanical Cylindrical Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical cylindrical locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Manufacturers:

   a. Sargent Manufacturing (SA) - 10G70/71 Series.
   b. No substitution.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latch bolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction tested for minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike where specified.

1. Manufacturers:

    a. Folger Adam EDC (FO)
    b. HES (HS)

B. Provide electric strikes with in-line power controller and surge suppessor by the same manufacturer as the strike with the combined products having a five year warranty.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.

5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15 mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.

    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dustproof strikes where thermal pins are required to project into the floor.

9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

11. Rail Sizing: Provide exit device rails factory sized for proper door width application.

12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Sargent Manufacturing (SA) – 80 Series.
    b. Detex Corporation (DX) – Advantex.
    c. No substitution.

C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed finish.

1. Provide keyed removable feature where specified in the Hardware Sets.

2. Provide stabilizers and mounting brackets as required.

3. Provide electrical quick connection wiring options as specified in the hardware sets.

4. Manufacturers:

    a. Sargent manufacturing (SA) – 980S Series.
    b. No substitution.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C positive Pressure Fire Test and be U.L. listed for use on fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: provide heavy duty, forged steel closer arms unless otherwise indicated in the Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors, where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA 156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

    a. Norton Door Controls (NO) – 7500 Series.
    b. Sargent Manufacturing (SA) – 351 Series.

C. Door Closers, Surface Mounted (Unitrol): Unitrol arms to have doors stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

   a. Norton Door Controls (NO) - Unitrol 7500 Series.
   b. No substitution.

2.12 ELECTROHYDRAULIC DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

   1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

   1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.

   2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Norton Door Controls – 6000 Series

2.13 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate.12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

   1. Manufacturers:

      a. Rixson (RF) - 980/990 Series.
      b. Sargent Manufacturing (SA) - 1560 Series.

2.14 ARCHITECTURAL TRIM

A. Door Protective Trim

   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than the door width (LDW) on stop side of single doors and I" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

   3. Where plates are applied to fire rated doors with top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consultant manufacturer's catalog and template book for specific requirements for size and applications.

   4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

      1. Stainless Steel: 300 series, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

   a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.15 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

   1. Manufacturers:

      a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

   1. Manufacturers:

      a. Rixson Door Controls (RF).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Sargent Manufacturing (SA).

2.16 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

a. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing agency and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko Products: ASSA ABLOY Architectural Door Accessories (PE).

2.17 ELECTRONIC ACCESSORIES

A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.

1. Manufacturers:

a. Alarm Controls (AK) – MCK Series
b. Securitron (SU) – MK Series

B. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

1. Manufacturers:

a. Securitron (SU) – AQD Series.
b. Altronix (AX) – Waypoint Series.

2.18 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.19 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS .3, Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4.Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field inspection (Punch-out Report): Reference Division 01 Section “Closout Procedures”. Final inspect installed door hardware and state in report whether work complies with or deviates from specification requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule.. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - Other
3. PE - Pemko
4. RO - Rockwood
5. SA – SARGENT
6. HS – HES
7. RF – Rixson
8. NO – Norton
9. MR – Markar
10. SU – Securitron
11. DX – Detex Corporation
12. AX – Altronics
13. KX - Keedex

Hardware Schedule

Set: S-01
Doors: MAIN EMPLOYEE/RECRUIT OFFICE ENTRY WITH AUTOMATIC OPERATOR
Description: ALIMINUM STOREFRONT | FUNCTION: ELECTRIC LATCH RETRACTION, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Continuous Hinge w/ cutout	_FM __SLF-HDI1 PT	PE
1	CVR Exit Dev (ELR, RX, NL, PULL)	55 56 70 AD8610 106 x 862	SA*
1	CVR Exit Dev (ELR, RX, PULL)	55 56 AD8610 862	SA*
1	Mortise Cylinder	70 43 (key Switch)	SA
2	Permanent Keyed Cylinder	By others	OT
1	Automatic Door Operator	6061	NO*
1	Surface Closer (TOP JAMB)	UNIJ7500	NO
1	Threshold & Weatherseal	Door Manufacturer	OT
2	Electric Power Transfer	EL-CEPT	SU*
2	ElectroLynx Harness	QC-C1500(P)	MK*
2	ElectroLynx Harness	QC-C__(P) as required	MK*
2	Position Switch	By security contractor	OT
1	Card Reader	By security contractor	OT
1	Door Operator Switch	502 (verify w/ as built arch. conditions)	NO*
1	Keyswitch	MKA (automatic operator)	SU*
1	Switch Post	500 (includes switch)	SU*
1	Power Supply	ADQ w/bds & relays as required	SU*
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINMU DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. PROVIDE POWER TO DOO OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02
Doors: MAIN EMPLOYEE ENTRY ELECTRIC LATCH RETRACTION
Description: ALUMINMU STOREFRONT | FUNCTION: ELECTRIC LATCH RETRACTION, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Continuous Hinge w/cutout	_FM__SLF-DH1 PT	PE
1	CVR Exit Dev	55 56 70 AD8610 106 x 862	SA*

1	CVR Exit Dev	55 56 AD8610 862	SA*
1	Permanent Keyed Core	By others	OT
2	Surface Closer (TOP JAMB)	UNIJ7500	NO
1	Threshold & Weatherseal	Door Manufacturer	OT
2	Electric Power Transfer	EL-CEPT	SU*
2	ElectroLynx Harness	QC-C1500(P)	MK*
2	ElectroLynx Harness	QC-C__(P) as required	MK*
2	Door Position Switch	By security contractor	OT
1	Card Reader	By security contractor	OT
1	Power Supply	AQD w/bds 7 relays as required	SU*
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL (CARD READER, NOT REQUIRED AT EVERY DOOR; SEE SECURITY DRAWINGS FOR REQUIREMENTS). ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02A
Doors: EMERGENCY EXIT ONLY - PAIR
Description: ALUMINUM STOREFRONT | FUNCTION: NO OUTSIDE OPERATION

2	Continuous Hinge	_FM__SLF-HD1	PE
2	CVR Exit Device (EO)	AD8610 EO	SA
2	Drop Plate	7788	NO
2	Surface Closer (STOP)	CPS7500	NO
2	Blade Stop Spacer Kit	6190/6191 as required	NO
1	Threshold & Weatherseal	by Door Manufacturer	OT
1	Sign by Owner	"Emergency Exit Only"	OT
2	Door Positions Switch	By security contractor	OT

Notes: EXIT ONLY. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. PROVIDE REQUIRED TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02B
Doors: EMERGENCY EXIT WITH KEYED ENTRY - PAIR
Description: ALUMINUM STOREFRONT | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

2 Continuous Hinge	_FM__SLF-HD1	PE
1 CVR Exit Device (NL, PULL)	70 AD8610 106 x 862	SA
1 CVR Exit Device (PULL)	AD8610 862l	SA
1 Permanent Keyed Core	By others`	OT
2 Surface Closer (TOP JAMB)	UNIJ7500	NO
1 Threshold 7 Weatherseal	Door manufacturer	OT
1 Sign by Owner	"Emergency Exit Only"	OT
2 Door Position Switch	By security contractor	OT

Notes: KEYED ENTRY ON ONE LEAF ONLY. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. PROVIDE REQUIRED TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02C
Doors: MAIN EMPLOYEE ENTRY ELECTRIFIED TRIM
Description: ALUMINUM STOREFRONT | FUNCTION: ELECTRIFIED EXIT DEVICE TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2 Continuous Hinge w/cutout	_FM__SLF-HD1 PT	PE
2 CVR Exit Dev (ELEC LEVER, RX)	55 AD8674 12v ETP	SA*
1 Exit Device Trim (NL)	70 106	SA
1 Permanent Keyed Core	By others	OT
2 Surface Closer (TOP JAMB)	UNI7500	NO
2 Electric Power Transfer	EL-CEPT	SU*
2 ElectroLynx Harness	QC-C1500 (P)	MK*
2 ElectroLynx Harness	QC-C__(P) as required	MK*
2 Door Position Switch	By security contractor	OT
1 Card Reader	By security contractor	OT
1`Power Supply	By security contractor	OT
1 Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL (CARD READER, NOT REQUIRED AT EVERY DOOR; SEE SECURITY DRAWINGS FOR REQUIREMENTS). ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS NOT REQUIRED. SECURITY CONTRACTOR SHALL PROVIDE LOCK POWER AND MAKE FINAL CONNECTIONS AT THE CONCEALED POWER TRANSFER. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02D
Doors: MAIN EMPLOYEE ENTRY MECHANICAL WITH AUTOMATIC OPERATOR
Description: ALUMINUM STOREFRONT | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION WITH ELECTRIC LATCH RETRACTION.

1 Continuous Hinge w/ cutout	_FM__SLF-HD1 PT	PE
1 Continuous Hinge	_FM__SLF-HD1	PE
1 CVR Exit Device (ELR,NL,PULL)	56 70 AD8610 106 x 862	SA*
1 CVR Exit Device (PULL)	AD8610 862	SA
1 Mortise Cylinder	70 43 (key by others)	SA
1 Permanent Keyed Core	By others	OT
1 Automatic Door Operator	6061	NO*
1 Surface Closer (TOP JAMB)	UNIJ7500	NO
1 Threshold & Weatherseal	Door Manufacturer	OT
1 Electric Power Transfer	EL-CEPT	SU*
1 ElectrolLynx Harness	QC-C1500(P)	MK*
1 ElectrolLynx Harness	QC-C___(P) as required	MK*
2 Door Position Switch	By security contractor	OT
1 Door Operator Switch	502(verify w/ as built arch. Conditions)	NO*
1 Keyswitch	MKA (automatic operator)	SU*
1 Switch Post	500 (includes switch)	NO*
1 Power Supply	AQD2 x PDB	SU*
1 Wiring & Riser Diagram	By hardware supplier as required	SU*

Notes: STOREROOM FUNCTION EXIT DEVICE. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. PROVIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02E

Doors: MAIN ASSOCIATE ENTRY – PAIR WITH MULLION AND AUTOMATIC OPERATOR
Description: ALUMINUM STOREFRONT | FUNCTION: ELECTRIC LATCH RETRACTION X ELECTRIFIED EXIT DEVICE TRIM

2 Continuous Hinge w/cutout	_FM__SLF-HD1 PT	PE
1 Removable Lockable Mullion	L980S	SA
1 Rim Exit Dev (ELR,RX,CLSRM)	55 56 70 8813 ETP	SA*
1 Rim Exit Dev (ELEC LEVER< RX)	55 70 8876-12v ETP	SA*
1 Mortise Cylinder	70 43 (key switch)	SA
1 Mullion Cylinder Kit	70 980C1	SA
4 Permanent Keyed Core	By others	OT
1 Automatic Door Operator	6061	NO*
1 Surface Closer (TOP JAMB)	UNIJ7500	NO
1 Threshold & Weatherseal	Door manufacturer	OT
1 Mullion Seal	5110BL	PE
2 Electric Power Transfer	EL-CEPT	SU*
2 ElectroLynx Harness	QC-C1500(P)	MK*
2 ElectrolLynx Harness	QC-C__(P) as required	MK*
2 Door Position Switch	By security contractor	OT

1	Card Reader	By security contractor	OT
1	Door Operator Switch	502 (verify w/as built arch. conditions)	NO*
1	Keyswitch	MKA (automatic operator)	SU*
1	Switch Post	500 (includes switch)	NO*
1	Power Supply	AQD X PDB	SU*
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. PROCIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-02F
Doors: MAIN ASSOCIATE ENTRY PAIR WITH MULLION
Description: HOLLOW METAL DOOR | FUNCTION: RIM EXIT DEVICE WITH ELECTRIFIED TRIM

4	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
2	Electric Hinge, Hvy Wt	T4A3386_QC8	US32D	MK*
1	Removable Lockable Mullion	L980S	PC	SA
2	Electric Rim Exit (ELEC LEVER,RX)	55 70 8876F-12v ETP	US32D	SA*
1	Mullion Cylinder Kit	70 980C1	US26D	SA
2	Surface Closer (STOP)	CPS7500	689	NO
3	permanent Keyed Core	By others	626	OT
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Threshold	273x3AFG		PE
1	Mullion Seal	5110BL		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
2	Door Bottom	216BDCFG		PE
2	Meeting Stile Seal	303AV		PE
2	ElectroLynx Harness	QC-C1500(P)		MK*
2	ElectroLynx Harness	QC-C__(P) as required		MK*
1	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
2	Door Position Switch	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND

WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-03
Doors: EMERGENCY EXIT ONLY – SINGLE ALUMINUM
Description: ALUMINUM STOREFRONT | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

1	Continuous Hinge	_FM__SLF-HD1	PE
1	Rim Exit Device (EO)	8910 EO	SA
1	Surface Closer	UNI7500	NO
1	Drop Plate	7788	NO
1	Blade Stop Spacer Kit	6190/6191 as required	NO
1	Threshold & Weatherseal	Door manufacturer	OT
1	Door Position Switch	By security contractor	OT
1	Sign by Owner	"Emergency Exit Only"	OT

Notes: EXIT ONLY. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. PROVIDE REQUIRED TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-03A
Doors: EMERGENCY EXIT WITH KEYED ENTRY - SINGLE
Description: ALUMINUM STOREFRONT | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

1	Continuous Hinge	_FM__SLF-HD1	PE
1	Rim Exit Device, (STORE, PULL)	70 8804 862	SA
1	Permanent Keyed Core	By others	OT
1	Surface Closer	UNI7500	NO
1	Drop Plate	7788	NO
1	Blade Stop Spacer Kit	6190/6191 as required	NO
1	Threshold & Weatherseal	Door Manufacturer	OT
1	Door Position Switch	By security contractor	OT
1	Sign by Owner	"Emergency Exit Only"	OT

Notes: KEYED ENTRY FROM EXTERIOR. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-03B
Doors: TRUCKERS LOUNGE/SMOKERS' CANOPY - SINGLE
Description: ALUMINUM STOREFRONT | FUNCTION: EXTERIOR LEVER, CLASSROOM FUNCTION

1	Continuous Hinge	_FM__SLF-HD1`	PE
1	Rim Exit Device (CLSRM, LEVER)	70 8813 ETP	SA
1	Permanent Keyed Core	By others	OT
1	Surface Closer	UNI7500	NO
1	Drop Plate	7788	NO
1	Blade Stop Spacer Kit	6190/6191 as required	NO
1	Threshold & Weatherseal	Door manufacturer	OT
1	Door Position Switch	By security contractor	OT

Notes: CLASSROOM FUNCTION EXIT DEVICE. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. HW SET 3B SHALL ALSO BE PROVIDED FOR SMOKERS CANOPY ENTRANCE DOORS THAT WILL NOT REQUIRE ELECTRONIC ACCESS CONTROLS. CONFIRM REQUIREMENTS WITH SECURITY DESIGNER. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-03C
Doors: AMZLMAIN ASSOCIATE ENRTY
Description: SINGLE ALUMINUM STOREFRONT | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

1	Continuous Hinge	_FM__SLF-HD1`	PE
1	Rim Exit Device (STORE, LEVER)	70 8804 862	SA
1	Permanent Keyed Core	By others	OT
1	Surface Closer	UNI7500	NO
1	Drop Plate	7788	NO
1	Blade Stop Spacer Kit	6190/6191 as required	NO
1	Threshold & Weatherseal	Door manufacturer	OT
1	Door Position Switch	By security contractor	OT

Notes: STOREROOM FUNCTION EXIT DEVICE. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. HW SET 3C SHALL ALSO BE PROVIDED FOR AMZL MAIN ASSOCIATE ENTRANCE DOORS THAT WILL NOT REQUIRE ELECTRONIC ACCESS CONTROLS. CONFIRM REQUIREMENTS WITH SECURITY DESIGNER. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-04
Doors: EMERGENCY EXIT ONLY – SINGLE HM

Description: SHELL EXTERIOR EGRESS DOOR | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Rim Exit Device (EO)	8810 EO	US32D	SA
1	Surface Closer (STOP)	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
1	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Door Position Switch	By security contractor		OT

Notes: EXIT DEVICE DOES NOT INCLUDE EXTERIOR TRIM. CONFIRM IF COMPLIANT WITH LOCAL CODE; OTHERWISE EQUIP WITH HW SET 4D. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICAN AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-04A
Doors: NON-FULFILLMENT BUSINESS UNIT
Description: EMERGENCY EXIT, STAND ALONE BATTERY ALARM | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Rim Exit Device (ALARM, STORE, PULL)AL 70 8804 PSB		US32D	SA*
2	Permanent Keyed Core	By others	626	OT
1	Surface Closer	CPS7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” CSK BEV	US32D	RO
1	Threshold	273x3AFG		PE
1	Rainguard	346C		PE
1	Gasketing (head)	2893AV		PE
1	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Door Position Switch	By security contractor		OT

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECY TO THOSE CONSTRUCTION CODES.

Set: S-04B
Doors: EXTERIOR TRUCKERS’ LOUNGE, TRUCKERS’ CAGE, SMOKING
Description: ACCESSIBLE SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR LEVER, CLASSROOM FUNCTION

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Rim Exit Device (CLSRM, LEVER)	70 8813 ETP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer (STOP)	CPS7500	689	NO
1	Armor Plate	K1050 (-F) 34” H x 2” LDW CSK	US32D	RO

1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jambs)	2903AV		PE
1 Door Bottom	216BDCFG		PE
1 Door Position Switch	By security contractor		OT

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-04C
Doors: SET NOT USED

1 Hardware Set	Currently not used		OT

Set: S-04D
Doors: EMERGENCY EXIT INCLUDING EXTERIOR TRIM
Description: SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

3 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Rim Exit Device(STORE, PULL)	70 8804 PSB	US32D	SA
1 Permanent Keyed Core	By others		OT
1 Surface Closer (STOP)	CPS7500	689	NO
1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jambs)	2903AV		PE
1 Door Bottom	216BDCFG		PE

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-04E
Doors: EMERGENCY EXIT ONLY - PAIR HM
Description: SHELL EXTERIOR EGRESS DOOR | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

6 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Removable Lockable Mullion	L980S	PC	SA
2 Rim Exit Device(EO)	8810 EO	US32D	SA

1	Mullion Cylinder kit	70 980C1	US26D	SA
1	Permanent Keyed Core	By others	626	OT
2	Surface Closer (STOP)	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
2	Door Bottom	216BDCFG		PE
2	Meeting Stile Seal	303AV		PE
1	Mullion Seal	5110BL		PE
2	Door Position Switch	by security contractor		OT

Notes: EXIT DEVICEE DOES NOT INCLUDE EXTERIOR TRIM. CONFIRM IF COMPLIANT WITH LOCAL CODE; OTHERWISE EQUIP WITH HW SET 4F. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-04F
Doors: EMERGENCY EXIT INCLUDING EXTERIOR TRIM - PAIR
Description: SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR PULL, STOREROOM FUNCTION

6	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Removable Lockable Mullion	L980S	PC	SA
2	Rim Exit Device(STORE, PULL)	70 8804 PSB	US32D	SA
1	Mullion Cylinder kit	70 980C1	US26D	SA
3	Permanent Keyed Core	By others	626	OT
2	Surface Closer (STOP)	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
2	Door Bottom	216BDCFG		PE
2	Door Position Switch	by security contractor		OT
2	Meeting Stile Seal	303AV		PE
1	Mullion Seal	5110BL		PE

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-05
Doors: TDR, TOM, SMOKER' CANOPY (ACCESS CONTROLED)
Description: SHELL EXTERIOR DOOR | FUNCTION: ELECTRIFIED EXIT DEVICE TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Rim Exit Device (ELEC, LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer (STOP)	CPS7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34" H x 2" LDW CSK	US32D	RO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Surface Armored Door Cord	KEEDEX K-DL38A		SU*
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. CARD IN / CARD OUT TO SHUNT EGRESS ALARM BY SECURITY CONTRACTOR. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-05A
Doors: MAIN ASSOCIATE, RECRUITMENT, SMOKERS' CANOPY ENTRY (WITHOUT AUTOMATIC OPERATOR)
Description: ALUMINUM STOREFRONT ACCESS CONTROLED ENTRANCE | FUNCTION: ELECTRIFIED EXIT DEVICE TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Continuous Hinge w/cutout	_FM__SLF-HD1 PT		PE
1	Rim Exit Dev (ELEC LEVER,RX)	55 70 8876-12v ETP		SA*
1	Permanent Keyed Core	By others		OT
1	Surface Closer (STOP)	UNI7500	689	NO
1	Drop Plate	7788	689	NO
1	Threshold & Weatherseal	Door manufacturer		OT
1	Electric Power Transfer	EL-CEPT		SU*
1	ElectroLynx Harness	QC-C1500(P)		MK*
1	ElectroLynx Harness	QC-C__(P) as required		MK*
1	Door Position Switch	By security contractor		OT

1	Card Reader (Qty varies)	By security contractor	OT
1	Power Supply	By security contractor	OT
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR FRAME AND FINISH. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES. CARD READER QUANTIES VARY; CONFIRM EXPECTIONS WITH SECURITY DESIGNER.

Set: S-05B

Doors: BUILDING ENTRY WITH AUTOMATIC OPERATOR - SINGLE
Description: HOLLOW METAL ACCESS CONTROLLED ENTRANCE | FUNCTION: ELECTRIC LATCH RETRACTION, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Continuous Hinge w/cutout	CFM__SLF-HD1 PT		PE
1	Rim Exit Dev (ELR, RX, NL, PULL)	55 56 70 8804 PSB	US32D	SA*
1	Mortise Cylinder	70 43 (key switch)	US32D	SA
2	Permanent Keyed Core	By others	626	OT
1	Automatic Door Operator	6061	689	NO*
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Electric Power Transfer	EL-CEPT		SU*
1	ElectrolLynx Harness	QC-C1500(P)		MK*
1	ElectrolLynx Harness	QC-C__(P) as required		MK*
1	Door position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Door Operator Switch	502 (verify w/as built arch conditions)		NO*
1	Keyswitch	MKA (automatic operator)		SU*
1	Switch Post	500 (includes switch)		NO*
1	Power Supply	AQD1 x PDB		SU*

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. CARD READERS AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. CONFIRM SWITCH POST REQUIREMENT. PROVIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH

E.C. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-05C
Doors: BUILDING ENTRY WITH AUTOMATIC OPERATOR, MAIN ASSOCIATE, RECRUITMENT, SMOKERS' CANOPY ENTRY – SINGLE
Description: ALUMINUM STOREFRONT ACCESS CONTROLLED ENTRY | FUNCTION: ELECTRIC LATCH RETRACTION, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Continuous Hinge w/cutout	_FM__SLF-HD1 PT	PE
1	Rim Exit Dev (ELR, RX, NL, PULL)	55 56 70 AD8504 862	SA*
1	Mortise Cylinder	70 43 (key switch)	SA
2	Permanent Keyed Core	By others	OT
1	Automatic Door Operator	6061	NO*
1	Threshold & Weatherseal	Door manufacturer	OT
1	Electric Power Transfer	EL-CEPT	SU*
1	ElectrolLynx Harness	QC-C1500(P)	MK*
1	ElectrolLynx Harness	QC-C__(P) as required	MK*
1	Door position Switch	By security contractor	OT
1	Card Reader	By security contractor	OT
1	Door Operator Switch	502 (verify w/as built arch conditions)	NO*
1	Keyswitch	MKA (automatic operator)	SU*
1	Switch Post	500 (includes switch)	NO*
1	Power Supply	AQD1 x PDB	SU*
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. CARD READERS AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. VERIFY FINISH ON HARDWARE ABOVE TO MATCH ALUMINUM DOOR AND FRAME FINISH. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY TO THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. CONFIRM SWITCH POST REQUIREMENT. PROVIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-05D
Doors: DSP
Description: SHELL EXTERIOR DOOR | FUNCTION: ELECTRIC LATCH RETRACTION, FAIL SECURE, INTEGRATED REQUEST TO EXIT

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Rim Exit Dev (ELEC LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT

1	Surface Closer (STOP)	CPS7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Threshold	273X3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (HEAD)	2893AV		PE
1	Gasketing (JAMBS)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Keyswitch	MKA (automatic operator)		SU*
1	Surface Armored Door Cord	KEEDEX K-DL38A		KX*
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. CARD READERS AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-06
Doors: EXISTING SHELL DOOR
Description: EXISTING SHELL DOORS WITH NO NEW HARDWARE REQUIREMENTS

1	Hardware	Existing		OT

Notes: ALL HARDWARE SHOULD BE COMPATABLE TO ACCCEPT 7-PIN SFIC CORES. ALL EXISTING HARDWARE SHALL CONFORM TO THE BASIC SECURITY DESIGN AS REQUEIRED BY TENANT ON A CASE BY CASE BASIS. IF EITHER OF THESE CONDITIONS ARE NOT MET, NEW MATERIAL SHOULD BE SCHEDULED.

Set: S-07
Doors: FIRE PUMP ROOM - PAIR
Description: SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR LEVER, STOREROOM FUNCTION

6	Hinge Hvy Wt	T4A3386 NRP	US32D	MK
2	Manual Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US262	RO
1	Storeroom Lock	70 8204 LNP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer (STOP)	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
2	Door Bottom	216BDCFG		PE

1	Latch Protector	320/321	US32D	RO

Notes: METAL ASTRAGAL BY DOOR SUPPLIER. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-07A
Doors: EMER EXIT ONLY SUPERVISED, FIRE PUMP ROOM (AMZL)
Description: SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR PULL, STOREFRONT FUNCTION

6	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	removable lockable Mullion	L980S	PC	SA
1	Rim Exit Device (EO)	8810 EO	US32D	SA
1	Rim Exit Device (STORE, PULL)	70 8804 PSB	US32D	SA
1	Mullion Cylinder Kit	70 980C1	US26D	SA
2	Permanent Keyed Core	By others	626	OT
2	Surface Closer (STOP)	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Mullion Seal	5110BL		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
2	Door Bottom	16BDCFG		PE
2	Meeting Stile Seal	303AV		PE

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICAN AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-07B
Doors: FIRE PUMP ROOM - SINGLE
Description: SHELL EXTERIOR DOOR | FUNCTION: EXTERIOR LEVER, STOREROOM FUNCTION

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Storeroom Lock	70 8204 LNP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	CPS7500	689	NO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Latch Protector	320/321	US32D	RO

Notes; PROVIDE TESTED AND APPROVED HAERWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-08
Doors: SET NOT USED

1	Hardware Set	Currently not used		OT

Set: S-09
Doors: GUARDHOUSE DOOR ACCESS CONTROLLED – HOLLOW METAL
Description: SHELL EXTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

3	Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1	Elec Mortise Lock (Fail Secure)	RX 70 8271-12V LNP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P) 7500	689	NO
1	Kickplate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Threshold	273x3AFG		PE
1	Rain Guard	346C		PE
1	Gasketing (head)	2893AV		PE
2	Gasketing (jambs)	2903AV		PE
1	Door Bottom	216BDCFG		PE
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Surface Armored Door Cord	KEEDEX K-DL38A		KX*
1	Power Supply	By security contractor		OT
1	Latch Protector	320/321	US32D	RO
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, POWER SUPPLY, AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set:S-09A
Doors: PREFAB GUARD HOUSE
Description: EXTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Hardware	Prefab guard house manufacturer	OT
1	Door Position switch	By security contractor	OT
2	Card Reader	By security contractor	OT
1	Power Supply	By security contractor	OT

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READERS, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR. GENERAL CONTRACTOR TO COORDINATE NEW HARDWARE INSTALLATION REQUIREMENTS WITH SUB-TRADES AND GUARD HOUSE MANUFACTURER. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-09B
Doors: GUARD HOUSE RESTROOM
Description: EXTERIOR DOOR | FUNCTION: SERVICE STATION FUNCTION, EXTERIOR LEVER

3 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Service Station Lock	28 70 10G44 LP	US26D	SA
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 Kickplate	K1050 10" H X 2” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jambs)	2903AV		PE
1 Door Bottom	216BDCFG		PE
1 Coat Hook	790	US26D	RO
1 Sign	BF689 Unisex/BF688 Wm’s/BF687 Mn’s Blue		RO

Notes: PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-09C
Doors: TRASH REMOVAL DOOR – HOLLOW METAL >36”
Description: SHELL EXTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

4 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Elec Mortise Lock (FAIL SECURE)	RX 70 8271-12V LNP	US32D	SA*
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer (STOP)	CPS7500	689	NO
1 Armor Plate	K1050 34" H X 2” LDW CSK	US32D	RO
1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jambs)	2903AV		PE
1 Door Bottom	216BDCFG		PE

1 Door position Switch	By security contractor		OT
2 Card Reader	By security contractor		OT
1 ElectroLynx Harness	QC-C1500(P)		MK*
1 ElectroLynx Harness	QC-C__(P) as required		MK*
1 Electric Power Transfer	EL-CEPT		SU*
1 Power Supply	By security contractor		OT
1 Latch Protector	320/321	US32D	RO
1 Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, POWER SUPPLY, AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM CODE COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-10
Doors: ROOF ACCESS
Description: EXTERIOR DOOR AT TOP OF ROOF ACCESS STAIR | FUNCTION: MECHANICAL CYLINDER LOCK, STOREROOM FUNCTION

3 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Storeroom Lock	28 70 10G04 LP	US26D	SA
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jamb)	2903AV		PE
1 Door Bottom	216BDCFG		PE
1 Door Position Switch	By security contractor		OT
1 Latch Protector	320/321	US32D	RO

Notes: ACCESS BY KEY FROM INSIDE ROOM OR STAIR. ALWAYS FREE EGREE FROM ROOF. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: S-10A
Doors: ROOF ACCESS (ALTERNATE DOUBLE CYLINDER)
Description: EXTERIOR DOOR AT TOP OF ROOF ACCESS STAIR | FUNCTION: MECHANICAL CYLINDER LOCK, STOREROOM FUNCTION

3 Hinge, Hvy Wt	T4A3386 NRP	US32D	MK
1 Storeroom Lock	70 8226 LNP	US32D	SA

2 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1 Dome Floor Stop	441	US26D	RO
1 Threshold	273x3AFG		PE
1 Rain Guard	346C		PE
1 Gasketing (head)	2893AV		PE
2 Gasketing (jamb)	2903AV		PE
1 Door Bottom	216BDCFG		PE
1 Door Position Switch	By security contractor		OT

Notes: KEYED BOTH SIDES. PROVIDE ONLY IF ACCEPTABLE TO LAHJ AND REQUIRED BY ROOF AND BUILDING CONFIGURATION. PROVIDE TESTED AND APPROVED HARDWARE FOR HURRICANE AND WINDSTORM COMPLIANT OPENINGS WHERE PROJECT IS SUBJECT TO THOSE CONSTRUCTION CODES.

Set: TI-01

Doors: SINGLE LEAF, TURNSTILE BYPASS, ASSOC ENTRY (AMZL)
Description: INTERIOR EGRESS DOOR | FUNCTION: ELECTRIFIED EXIT DEVICE LEVER TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1 Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1 Rim Exit Dev (ELEC LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
3 Silencer	608-RKW		RO
1 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1 ElectroLynx Harness	QC-C1500(P)		MK*
1 Door Position Switch	By security contractor		OT
1 Card Reader (QTY VARIES)	By security contractor		OT
1 Power Supply	By security contractor		OT
1 Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. POWER SUPPLY, CARD READERS AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. CARD READER ON EGRESS SIDE WILL SHUNT BLDG ALARM AS AN ACCESS CONTROLLED REQUEST TO EXIT SIGNAL. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. COORDINATE CARD READER QUANTITIES WITH SECURITY DRAWINGS.

Set: TI-01A

Doors: SINGLE LEAF, TURNSTILE BYPASS EMERGENCY EXIT ONLY
Description: INTERIOR EGRESS DOOR | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

3 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK

1	Rim Exit Device (EO)	8810 EO	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
3	Silencer	608-RKW		RO

Notes: EXIT ONLY.

Set: TI-01B
Doors: SINGLE LEAF, GUERNEY (>36” WIDE)
Description: INTERIOR DOOR | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

4	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Exit Device (EO)	8810 EO	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
3	Silencer	608-RKW		RO

Notes: EXIT ONLY.

Set: TI-01C
Doors: RECRUITMENT OFFICE VESTIBULE
Description: ALUMINUM | FUNCTION: ELECTRIFIED EXIT DEVICE LEVER TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Continuous Hinge w/cutout	CFM__SLF-HD1 PT		PE
1	Rim Exit Dev (ELEC LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	UNI7500	689	NO
1	Drop Plate	7788	689	NO
1	Blade Stop Spacer Kit	6190/6191 as required	689	NO
1	Electric Power Transfer	EL-CEPT		SU*
1	ElectroLynx Harness	QC-C1500(P)		MK*
1	ElectroLynx Harness	QC-C__(P) as required		MK*
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, POWER SUPPLY, AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. CARD IN / CARD OUT TO SHUNT EGRESS ALARM BY SECURITY CONTRACTOR. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. INSTALLER SHALL PROVIDE REX CONNECTION FROM TRIM TO HINGE.

Set: TI-01C(ALT)
Doors: RECRUITMENT OFFICE TURNSTILE, VISITOR BYPASS WITH AUTOMATIC OPERATOR
Description: ALUMINUM | FUNCTION: ELECTRIFIED EXIT DEVICE LEVER TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

1	Continuous Hinge w/cutout	CFM__SLF-HD1 PT		PE
1	Rim Exit Dev (ELEC LEVER, RX)	55 56 70 8804-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Mortise Cylinder	70 43 (key switch)	US32D	SA
1	Automatic Door Operator	6061	689	NO*
2	Door Operator Switch	502 (verify w/as built arch conditions)		NO*
1	Keyswitch	MKA (automatic operator)		SU*
1	Electric Power Transfer	EL-CEPT		SU*
1	ElectroLynx Harness	QC-C1500(P)		MK*
1	ElectroLynx Harness	QC-C__(P) as required		MK*
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Power Supply	ADQ1 x PDB		SU*

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, POWER SUPPLY, AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. EPT PREP TO BE COORDINATED BY ALUMINUM STOREFRONT MANUFACTURER. CARD IN / CARD OUT TO SHUNT EGRESS ALARM BY SECURITY CONTRACTOR. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. LOCAL POWER SUPPLY IS REQUIRED. DOOR HARDWARE INSTALLER SHALL INSTALL POWER SUPPLY IN CONCEALED LOCATION NEAR BY THE DOOR IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS. PROVIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C. INSTALLER SHALL PROOVIDE REX CONNECTION FROM TRIM TO HINGE.

Set: TI-01D
Doors: DOUBLE LEAF, TURNSTILE BYPASS, ASSOC ENTRY (AMZL)
Description: INTERIOR EGRESS DOOR | FUNCTION: ELECTRIFIED EXIT DEVICE LEVER TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

4	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2	Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Removable Lockable Mullion	L980S	PC	SA
1	Rim Exit Dev (ELEC LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1	Mullion Cylinder Kit	70 980C1	US26D	SA
3	Permanent Keyed Core	By others	626	OT
2	Surface Closer	(P)7500	689	NO
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
2	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Silencer	608-RKW		RO
1	Mullion Seal	5110BL		PE
2	ElectroLynx Harness	QC-C300(P)		MK*

2	Door Position Switch	By security contractor	OT
1	Card Reader (QTY VARIES)	By security contractor	OT
1	Power Supply	By security contractor	OT
1	Wiring & Riser Diagram	By hardware supplier as required	

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS, POWER SUPPLY, CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. CARD READER ON EGRESS SIDE WILL SHUNT BLDG ALARM AS AN ACCESS CONTROLLED REQUEST TO EXIT SIGNAL. LOCK POWER SHALL BE PROVIDED BY THE SECURITY CONTRACTOR. COORDINATE CARD READE QUANTITIES WITH SECURITY DRAWINGS.

Set: TI-01E
Doors: DOUBLE LEAF, TURNSTILE BYPASS EMERGENCY EXIT ONLY
Description: INTERIOR EGRESS DOORS | FUNCTION: NO EXTERIOR TRIM OR OUTSIDE OPERATION

6	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Removable Lockable Mullion	L980S	PC	SA
2	Rim Exit Dev (EO)	8810 EO	US32D	SA
1	Mullion Cylinder Kit	70 980C1	US26D	SA
1	Permanent Keyed Core	By others	626	OT
2	Surface Closer	(P)7500	689	NO
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
2	Silencer	608-RKW		RO
1	Mullion Seal	5110BL		PE

Notes: EXIT ONLY

Set: TI-02
Doors: CARD IN/CARD OUT (LOCKED IN BOTH DIRECTIONS)
Description: INTERIOR WOOD DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT, LOCKED BOTH DIRECTIONS

2	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Elec Mortise Lock (FAIL SAFE)	RX 70 8272-12V LNP	US26D	SA*
2	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Floor Stop	446	US26D	RO
1	ElectroLynx Harness	QC-C300(P)		MK*
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Emergency Door Release	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL CARD REQUIRED THROUGH BOTH DIRECTIONS OF TRAVEL. CARD READERS, EMERGENCY DOOR RELEASE BUTTON, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR. THIS OPENING IS NOT EGRESS COMPLIANT.

Set: TI-02A
Doors: EGRESS CORRIDOR ENTRY
Description: INTERIOR EGRESS DOOR | FUNCTION: EXTERIOR LEVER, STOREROOM FUNCTION

3	Hinge, Hvy Wt	T4A3786	US26D	MK
1	Rim Exit Device (STORE, LEVER)	70-8804 ETP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE
1	Sweep	315CN		PE
1	Door Position Switch	By security contractor		OT
1	Sign by Owner	“Emergency Exit Only – Alarm Will Sound”		OT

Notes: DOOR SHALL BE CONFIGURED AS EMERGENCY EXIT ONLY. DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-02B
Doors: DAY ONE TRAINING, TRUCKERS’ LOUNGE, DRIVER CHECK IN, HUB STAGING ACCESS FROM WAREHOUSE (HM DOOR)
Description: ACCESS CONTROLED INTERIOR EGRESS DOOR | FUNCTION: ELECTRIFIED EXIT DEVICE LEVER TRIM, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hinge, Hvy Wt.	T4A3786-QC8	US26D	MK*
1	Rim Exit Device	55 70 8876-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
3	Silencer	608-RKW		RO
1	ElectroLynx Harness	QC-C300(P)		MK*
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. CARD READER EGRESS WILL SHUNT BLDG ALARM AS AN ACCESS CONTROLLED REQUEST TO EXIT SWITCH.

Set: TI-03
Doors: SET NOT USED

1	Hardware set	Currently not used	OT

Set: TI-04
Doors: TRAINING, CAREER CHOICE CLASSROOM
Description: INTERIOR DOOR | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Fire Exit HW (PASSAGE)	12 8815 ETP	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE

Set: TI-04A
Doors: ACADEMY ROOM, FIRST DAY TRAINING (ACCESS CONTROLS NOT REQUIRED)
Description: INTERIOR DOOR | FUNCTION: EXTERIOR LEVER, CLASSROOM FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Fire Exit HW (CLASSROOM)	12 70 8813 ETP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH Side)	K1050 (-F) 34” H X 2’ LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE

Set: TI-04B
Doors: ACADEMY ROOM, FIRST DAY TRAINING (ACCESS CONTROLS NOT REQUIRED) - PAIR
Description: INTERIOR DOOR | FUNCTION: EXTERIOR LEVER, CLASSROOM FUNCTION

6	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2	SVR Fire Exit HW (CLASSROOM)	12 70 NB8713 ETP	US32D	SA
2	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Surface Closer (STOP)	CPS7500	689	NO
2	Armor Plate	K1050 (-F) 34” CSK BEV	US32D	RO
1	Dome Floor Stop	441	US26D	RO
1	Gasketing	S88D		PE
2	Meeting Stiles	305CN		PE

Set: TI-05
Doors: ACADEMY ROOM/WAREHOUSE/RECRUT OFFICE EMERGENCY EXIT
Description: INTERIOR EGRESS DOOR | FUNCTION: NO EXTERIOR TRIM, EMERGENCY EXIT ONLY

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Exit Device (EO)	8810	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO
1	Door Position Switch	By security contractor		OT
1	Sign by Owner	“Emergency Exit Only – Alarm Will Sound”		OT

Notes: NO HARDWARE SHALL BE PROVIDED ON WAREHOUSE SIDE OF THE DOOR. DOOR POSITION SWITCH SHALL BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-06
Doors: WELLNESS ENTRY
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, CLASSROOM FUNCTION

4	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Classroom Lock	28 70 10G37 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer (HO)	7500H	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO

Notes: GASKETING AT RATED OPENINGS. OMIT HOLD OPEN ARM ON CLOSER AT RATED OPENING.

Set: TI-07
Doors: OFFICE, CONFERENCE ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, ENTRANCE/OFFICE FUNCTION, PUSH BUTTON INSIDE

3	Hinge	TA2714 NRP	US26D	MK
1	Entry/Office Lock	28 70 10G05 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO
1	Coat Hook	790	US26D	RO

Notes: GASKETING AT RATED OPENING. CLOSER AT RATED OPENING AND FIRST AID WAITING. COAT HOOK NOT REQUIRED FOR LOCKABLE CONFERENCE ROOMS.

Set: TI-7A
Doors: COMMAND CENTER, OPEN OFFICE ENTRY
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, ENTRANCE/OFFICE FUNCTION, PUSH BUTTON INSIDE

3 Hinge	TA2714 NRP	US26D	MK
1 Entry/Office Lock	28 70 10G05 LP	US26D	SA
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO

Set: TI-08
Doors: CONFERENCE ROOM, AMZL STORAGE ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, PASSAGE FUNCTION

3 Hinge	TA2714 NRP	US26D	MK
1 Passage Latch	28 10U15 LP	US26D	SA
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO

Set: TI-08A
Doors: CONFERENCE, JANITOR (AMZL),
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, PASSAGE FUNCTION

3 Hinge	TA2714 NRP	US26D	MK
1 Passage Latch	28 10U15 LP	US26D	SA
1 Surface Closer	(P)7500	986	NO
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO

Set: TI-09
Doors: JANITOR, AMZL TRAINING ROOM STORAGE, SHEVEL CLOSET WITH SINGLE DOOR
Description: INTERIOR DOOR | MECHANICAL LOCK, STOREROOM FUNCTION

3 Hinge	TA2714 NRP	US26D	MK
1 Storeroom Lock	28 70 10G04 LP	US26D	SA
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer (HO)	7500H	689	NO
1 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO

Notes: GASKETING AT RATED OPENINGS. OMIT HOLD OPEN ARM ON CLOSER AT RATED OPENINGS.

Set: TI-09A
Doors: AV CLOSET, VENDING STORAGE
Description: 4’ x 8’ INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

4	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer (HO)	7500H	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO

Notes: GASKETING AT RATED OPENINGS. OMIT HOLD OPEN ARM ON CLOSER AT RATED OPENINGS.

Set: TI-09B
Doors: MHE SHAFT – UNEVEN PAIR
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

2	Continuous Hinge	CFM__HD1		PE
1	Coordinator	2600 x FB	BLK	RO
2	Closer Mounting Bracket	2601AB/C as required	BLK	RO
1	Set Automatic Flush Bolts	2842/2942	US26D	RO
1	Dustproof Strike	570	US26D	RO
1	Mortise Exit Device	12 70 8904 ETP	US32D	RO
1	Permanent Keyed Core	By others	626	OT
2	Surface Closer	PRO7500	689	NO
2	Surface Overhead Stop	9-X36	630	RF
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Floor Stop	446	US26D	RO
2	Door Sweep	315CN		PE
1	Gasketing	S88D		PE
1	Overlapping Metal Astragal	357SP x S88D		PE

Notes: GASKETING AT RATED OPENINGS.

Set: TI-10
Doors: IDF ROOM
Description: INTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Elec Mortise Lock (FAIL SECURE)	RX 70 8271-12V LNP	US26D	SA*
1	Surface Closer	(P)7500	689	NO
1	Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1	Floor Door	446	US26D	RO
3	Silencer	608-RKW		RO
1	ElectroLynx Harness	QC-C300(P)		MK*
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-11
Doors: STAFFING AGENCY, ENS SITE ZONE 3
Description: INTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hing, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Elec Mortise Lock (FAIL SECURE)	RX 70 8271-12V LNP	US26D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Kick Plate (PUSH SIDE)	K1050 10” H X 2” LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34" H X 1” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO
1	ElectroLynx Harness	QC-C300(P)		MK*
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Power Supply	BPS by security contractor		SU*
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-11A
Doors: ENS PICKUP, AMZL/AMXL TRAINING (DUTCH DOOR)
Description: ACCESS CONTROLLED CARD IN/OUT HOLLOW METAL DUTCH DOOR | FUNCTION: TOP LEAF SECURED TO BOTTOM WITH EXIT LATCH. BOTTOM LEAF CARD IN/OUT WITH SPRING HINGES

2	Hinge, Hvy Wt (TOP PANEL)	T4A3786 NRP	US26D	MK
2	Hinge, Spring (BOTTOM PANEL)	1502	US26D	MK
1	Fail secure Lock	RX 28 70 10G71-12v LP	US26D	SA*
1	Exit Latch	28 10G15-3 LP	US26D	SA
1	Permanent Keyed Core	By others		OT
1	Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1	Wall Stop	409	US26D	SA
1	Floor Stop	446	US26D	RO
4	Silencer	608-RKW		RO
1	Electric Power Transfer	EL-CEPT		SU*
1	ElectroLynx Harness	QC-C306(P)		MK*
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		SU*
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS ON LOWER LEAF. CARD READERS, DOOR POSITION SWITCHES, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR. THE TOP LEAF DOOR CONTACT SHALL BE PROGRAMMED AS INACTIVE WHEN THE INTRUSION DETECTION SYSTEM IS DISARMED.

Set: TI-12
Doors: STORAGE ROOM, ELEVATOR MACHINE ROOM, UTILITY ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

3	Hinge	TA2714 NRP	US26D	MK
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO

Set: TI-12A
Doors: HR STORAGE
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

3	Hinge	TA2714 NRP	US26D	MK
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT

1 Surface Closer	(P)7500	689	NO
1 Kick Plate (PUSH SIDE)	K1050 10” H X 2” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO

Set: TI-13
Doors: BREAKROOM RATED PAIR
Description: INTERIOR EGRESS PAIR | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

6 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2 CVR Fire Exit HW (PASSAGE)	12 NB MD8615 ETP	US32D	SA
2 Surface Closer (STOP)	CPS7500	689	NO
2 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32d	RO
1 Gasketing	S88D		PE
2 Sweep	315CN		PE
2 Meeting Stile Seal	305CN		PE

Notes: GASKETING AT RATED OPENING.

Set: TI-13A
Doors: LOCKER ROOM/RESTROOM VESTIBULE TO WAREHOUSE EMERGENCY EXIT ONLY
Description: INTERIOR DOOR | FUNCTION: NO EXTERIOR TRIM, EMERGENCY EXIT ONLY, VERTICAL ROD EXIT DEVICES

6 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2 CVR Fire Exit HW (EO)	12 NB MD8610 EO	US32D	SA
2 Surface Closer	CPS7500	689	NO
2 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1 Gasketing	S88D		PE
2 Sweep	315CN		PE
2 Meeting Stile Seal	305CN		PE

Set: TI-13B
Doors: BREAK ROOM/RESTROOM VESTIBULE TO WAREHOUSE EMERGENCY EXIT ONLY
Description: INTERIOR DOOR | FUNCTION: NO EXTERIOR TRIM, EMERGENCY EXIT ONLY, RIM EXIT DEVICES X REMOVABLE MULLION.

6 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1 Removable Lockable Mullion	12 L980S	PC	SA
2 Rim Fire Exit HW (EO)	12 8810 EO	US32D	SA
1 Mullion Cylinder Kit	70 980C1	US26D	SA
1 Permanent Keyed Core	By others	626	OT
2 Surface Closer (STOP)	CPS7500	689	NO
2 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO

1 Mullion Seal	5110BL		PE
1 Gasketing	S88D		PE
2 Sweep	315CN		PE
2 Meeting Stile Seal	305CN		PE

Set: TI-14
Doors: BREAKROOM NON RATED PAIR
Description: INTERIOR DOOR | FUNCTION: PUSH/PULL PLATES, NO LOCK FUNCTION

6 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2 Pull Plate	110x70C 4” x 16”	US32D	RO
2 Push Plate	70G 4” x 20”	US32D	RO
2 Surface Closers	(P)7500	689	NO
2 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2 Door Stop & Holder	472	US26D	RO
2 Edge Guard (latch Edge)	EG308	630	MR
2 Silencer	608-RKW		RO

Set: TI-15
Doors: BREAKROOM SWING DOOR
Description: INTERIOR DOOR | FUNCTION: PUSH/PULL PLATES, NO LOCK FUNCTION

3 Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1 Pull Plate	110x70C 4” x 16”	US32D	RO
1 Push Plate	70G 4” x 20”	US32D	RO
1 Surface Closer	(P)7500	689	NO
1 Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Door stop & Holder	472	US26D	RO
1 Edge Guard (LATCH EDGE)	EG308	630	MR
3 Silencer	608-RKW		RO

Set: TI-16
Doors: UNISEX TOILET ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, INDICATOR PRIVACY FUNCTION

3 Hinge	TA2714 NRP	US26D	MK
1 Indicator Privacy Lock	LB V21 8266 LNP	US26D	SA
1 Surface Closer	(P)7500	689	NO
1 Mop Plate (PULL SIDE)	K1050 10” H X 1” LDW CSK	US32D	RO
1 Armor Plate (PUSH SIDE)	Ki050 (-F) 34” H X 2” LDW CSK	US32D	RO
1 Floor Stop	446	US26D	RO
3 Silencer	608-RKW		RO
1 Coat Hook	790	US26D	RO
1 Sign	BF689 Unisex	Blue	RO

Set: TI-16A
Doors: NEW MOTHERS ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, INDICATOR PRIVACY FUNCTION

3	Hinge	TA2714 NRP	US26D	MK
1	Indicator Privacy Lock	LB V21 8266 LNP	US26D	SA
1	Surface Closer	(P)7500	689	NO
1	Mop Plate (PULL SIDE)	K1050 10" H X 1” LDW CSK	US32D	RO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO
1	Coat Hook	790	US26D	RO

Set: TI-17
Doors: TRUCKERS’ CAGE, HRV CAGE (WITH PANIC HARDWARE), HUB STAGING ACCESS FROM WAREHOUSE (FENCE)
Description: INTERIOR EGRESS | FUNCTION: ELECTRIFIED RIM EXIT DEVICE WITH LEVER, FAIL SECURE

3	Hinges	By gate manufacturer		OT
1	Rim Exit Dev (ELEC LEVER, RX)	55 70 8876-12v ETP	US32D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Surface Armored Door Cord	KEEDEX K-DL38A		KX*
1	Power Supply	By security contractor		OT
1	Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD		DX
1	Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD (trim)		DX
1	Keedex Box	K-BX711150 by gate manufacturer		KX
1	ElectroLynx Harness	QC-C1500P		MK
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. POWER SUPPLY, CARD READERS AND DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR. CARD READER TO SHUNT EGRESS ALARM.

GATE PLATE KIT INCLUDES PLATE (ADJUSTABLE FROM 32” TO 52” WIDE), STRIKE LATCH RECEIVER BRACKET, AND GATE LATCH PROTECTOR.

FENCE MANUFACTURER SHALL PROVIDE STEEL PLATE TO BLOCK ACCESS TO INTERIOR DOOR HARDWARE FROM UNSECURE SIDE. PLATE SHALL EXTEND 12" ABOVE AND BELOW AND TO BOTH SIDES OF DOOR HARDWARE. FENCING MANUFACTURER TO PROVIDE STEEL PLATE ADJACENT TO GATE DOOR AND KEEDEX BOX FOR EXIT DEVICE TRIM. KEEDEX BOX TO BE MOUNTED 40” AFF TO CENTER OF BOX, FACE FLUSH WITH PUSH SIDE OF GATE. FENCING MANUFACTURER TO COORDINATE CLOSER MOUNTING SURFACE.

Set: TI-18
Doors: EMPLOYEE RESOURCE CENTER, MULTIFAITH, ABLUTION ROOM, MOTHER'R ROOM LOBBY
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, PASSAGE FUNCTION

3	Hinge	TA2714 NRP	US26D	MK
1	Passage Latch	28 10U15 LP	US26D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34" H X 2" LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34" H X 1" LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO

Set: TI-19
Doors: SET NOT USED

4	Hardware Set	Currently not used		OT

Set: TI-20
Doors: ELECTRICAL SWITCH, DEMARK (ENS), IT (ENS) ROOM , UTILITY ROOM (WHEN PANIC HARDWARE REQUIRED) - SINGLE
Description: INTERIOR EGRESS DOOR | FUNCTION: EXTERIOR LEVER, STOREROOM FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Exit Device (STORE< LEVER)	70-8804 ETP	US32D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34" H X 2" LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34" H X 1" LDW CSK	US32D	RO
3	Silencer	608-RKW		RO

Notes: PROVIDE FIRE RATED EXIT HARDWARE AND GASKETING AT RATED OPENINGS.

Set: TI-20A
Doors: ELECTRICAL SWITCH, DEMARK (ENS), IT (ENS) ROOM - PAIR
Description: INTERIOR EGRESS DOOR | FUNCTION: EXTERIOR LEVER, STOREROOM FUNCTION

6	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1`	Removable Lockable Mullion	L980S	PC	SA
2	Rim Exit Device (STORE, LEVER)	70-8804 ETP	US32D	SA
1	Mullion Cylinder Kit	70 980C1	US26D	SA
1	Permanent Keyed Core	By others	626	OT
2	Surface Closer	(P)7500	689	NO
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34" H X 2" LDW CSK	US32D	RO
2	Armor Plate (PULL SIDE)	K1050 (-F) 34" H X 1" LDW CSK	US32D	RO

2	Silencer	608-RKW	RO
1	Mullion Seal	5110BL	PE

Notes: PROVIDE FIRE RATED EXIT HARDWARE AND GASKETING AT RATED OPENINGS.

Set: TI-21
Doors: DEMARC ROOM
Description: INTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

2	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Elec Mortise Lock (FAIL SECURE)	RX 70 8271-12V- LNP	US26D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Kick Plate (INTERIOR SIDE)	K1050 10” H X 2” LDW CSK	US32D	RO
1	Armor Plate (WAREHOUSE SIDE)	K1050 (-F) 34” X 2’ LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE
1	Sweep	315CN		PE
1	ElectroLynx Harness	QC-C300(P) as required		MK*
1	Door Position Switch	By security contractor		OT
1	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: THRESHOLD REQUIRED IF BLDG IS NOT DRIED IN. ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR. ARMOR PLATE WAREHOUSE SIDE; KICK PLATE INTERIOR SIDE.

Set: TI-22
Doors: RECRUITMENT, STAFFING TELCOM ROOM
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

3	Hinge	TA2714 NRP	US26D	MK
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE

Set: TI-23
Doors: MDF, IT TEAM ROOM
Description: INTERIOR DOOR | FUNCTION: ELECTRIFIED LEVER MORTISE LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Electric Hinge, Hvy Wt	T4A3786-QC8	US26D	MK*
1	Elec Mortise Lock (FAIL SECURE)	RX 70 8271-12V LNP	US26D	SA*
1	Permanent Keyed Core	By others	626	OT
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE
1	ElectroLynx Harness	QC-C400(P)		MK*
1	Door Position Switch	By security contractor		OT
2	Card Reader	By security contractor		OT
1	Power Supply	By security contractor		OT
1	Wiring & Riser Diagram	By hardware supplier as required		

Notes: ACCESS BY AUTHORIZED CARD CREDENTIAL. ALWAYS FREE EGRESS. CARD READER, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR. AT NO TIME IS ANY TYPE OF WINDOW KIT ALLOWED IN THE MDF DOOR LEAF PER TENANT SECURITY REQUIREMENTS. THRESHOLD REQUIRED IF BUILDING IS NOT DRIED IN.

Set: TI-24
Doors: RECRUTING OFFICE RESTROOM
Description: INTERIOR DOOR | FUNCTION: PUSH/PULL PLATES, NO LOCK FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Pull Plate	110x70C 4” x 16”	US32D	RO
1	Push Plate	70G 4” x 20”	US32D	RO
1	Surface Closer	(P)7500	689	NO
1	Kick Plate (PUSH SIDE)	K1050 10" H X 2” LDW CSK	US32D	RO
1	Mop Plate (PULL SIDE)	K1050 10” H X 1” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
3	Silencer	608-RKW		RO
1	Sign	BF689 Unisex/BF688 Wm’s/BF687 Mn’s BLUE		RO

Set: TI-25
Doors: TEMPORAY IDF CAGE
Description: CAGE DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION, FAIL SECURE ELECTRIC STRIKE

3	Hinges	By gate manufacturer		OT
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	by others	626	OT
1	Electric Strike (FAIL SECURE)	1006 CS	630	HS*
1	Surface Closer	(P)7500	689	NO

1 Door Position Switch	By security contractor		OT
2 Card Reader	By security contractor		OT
1 Power Supply	By security contractor		SU*
1 Latch Protector	320/321	US32D	RO
1 Keedex Box	K-BXRHO by gate manufacturer		KX
1 Wiring & Riser Diagram	By hardware supplier as required		

Notes: FENCE MANUFACTURER SHALL PROVIDE KEEDEX BOX AND STEEL PLATE TO BLOCK ACCESS TO INTERIOR DOOR HARDWARE FROM UNSECURE SIDE. PLATE SHALL EXTEND 12" ABOVE AND BELOW AND TO BOTH SIDES OF DOOR HARDWARE. CAGE FRAME SHALL INCLUDE STRIKE BOX SIZED TO ACCEPT ELECTRIC STRIKE. ELECTRIC STRIKE TO BE FAIL SECURE. CARD READER IN / OUT. CARD READER, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-26
Doors: MAINTENANCE, SAFETY, DEMARC CAGE (NO ACCESS CONTROL)
Description: CAGE DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

3 Gate Hinges	By gate manufacturer		OT
1 Storeroom Lock	28 70 10G04 LP	US26D	SA
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 Door Position Switch	By security contractor		OT
1 Keedex Box	K-BXRHO by gate manufacturer		KX

Notes: GATE MANUFACTURER SHALL PROVIDE KEEDEX BOX AND STEEL PLATE TO BLOCK ACCESS TO INTERIOR DOOR HARDWARE FROM UNSECURE SIDE. STEEL KEEDEX BOX TO BE MOUNTED 41” AFF TO CENTER OF BOX. FACE FLUSH WITH PUSH SIDE OF GATE**. STEEL PLATE SHALL EXTEND 12" ABOVE AND BELOW AND TO BOTH SIDES OF DOOR HARDWARE.** MOUNTING PLATE FOR CLOSER AND LOCKSET COORDINATION SHALL BE PROVIDED BY GATE MANUFACTURER.

*DOOR POSITION SWITCH REQUIRED FOR SUPERVISED DEMARC CAGE ONLY

Set: TI-26A
Doors: IT, PARTS STOR, MSC, AR MAINT, HRV, DEMARK, BYPASS (ACCESS CONTROL, NO PANIC)
Description: CAGE DOOR | FUNCTION: ELECTRIFIED CYLINDRICAL LEVER LOCK, FAIL SECURE, INTEGRATED REQUEST TO EXIT

3 Hinges	By gate manufacturer		OT
1 Fail Secure Lock	RX 28 70 10G71-12V LP	US26D	SA*
1 Permanent Keyed Core	By others	626	OT
1 Surface Closer	(P)7500	689	NO
1 ElectroLynx Harness	QC-C1500(P)		MK*
1 Door Position Switch	By security contractor		OT
1 Surface Armored Door Cord	KEEDEX K-DL38A		KX*
1 Card Reader (Qty varies)	By security contractor		OT

1 Power Supply	By security contractor		SU*
1 Latch Protector	320/312C	US32D	RO
1 Keedex Box	K-BXRHO by gate manufacturer		KX
1 Wiring 7 Riser Diagram	By hardware supplier as required		

NOTES: GATE MANUFACTURER SHALL PROVIDE KEEDEX BOX AND STEEL PLATE TO BLOCK ACCESS TO INTERIOR DOOR HARDWARE FROM UNSECURE SIDE. KEEDEX BOX TO BE MOUNTED 41” AFF TO CENTER OF BOX, FACE FLUSH WITH PUSH SIDE OF GATE. **STEEL PLATE SHALL EXTEND 12" ABOVE AND BELOW AND TO BOTH SIDES OF DOOR HARDWARE**. MOUNTING PLATE FOR CLOSER AND LOCKSET COORDINATION SHALL BE PROVIDED BY GATE MANUFACTURER. CARD READERS, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR.

AT ALL CAGES, THIS SET SHALL BE APPLIED ONLY TO PEDESTRIAN GATES. SLIDING GATES THAT LEAD INTO CAGES DO NOT REQUIRE ACCESS CONTROL OR ELECTRIFIED LOCKING HARDWARE.

Set: TI-26B
Doors: SMOKERS’ CANOPY GATE
Description: CAGE DOOR | FUNCTION: NO EXTERIOR TRIM, EMERGENCY EXIT ONLY

3 Hinges	By gate manufacturer		OT
1 Rim Exit Device (EO)	8810 EO	US32D	SA
1 Surface Closer	(P)7500	689	NO
1 Door Position Switch	By security contractor		OT
1 Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD		DX

Notes: FENCE MANUFACTURER SHALL PROVIDE MOUNTING PLATE FOR CLOSER. MOUNTING PLATE FOR CLOSER AND LOCKSET COORDINATION SHALL BE PROVIDED BY GATE MANUFACTURER. DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-26C
Doors: SECURE ASSOCIATE PARKING GATE
Description: SECURE ASSOCIATE PARKING GATE | ELECTRONIC ACCESS CONTROLLED

3 Hinges	By gate manufacturer		OT
1 Rim Exit Device (ELECTRIFIED)	40 09DN LD ERxEXxW FC3EC1W 99	630	DE
1 Permanent Keyed Core	By others	626	OT
1 Rim / Mortise Cylinder	72 34/43 as required	US32D	SA
1 Surface Closer	(P)7500	689	NO
1 Door Position Switch	By security contractor		OT
1 Card Reader	By security contractor		OT
1 Outdoor Rated Power Supply	Waypoint3		AX
1 Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD		DX
1 Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD (TRIM)		DX
1 Keedex Box	K-BX711150 by gate manufacturer		KX
1 Wiring & Riser Diagram	By hardware supplier as required		

NOTES: GATE MANUFACTURER SHALL PROVIDE KEEDEX BOX AND STEEL PLATE TO BLOCK ACCESS TO INTERIOR DOOR HARDWARE FROM UNSECURE SIDE. PLATE SHALL EXTEND 12" ABOVE AND BELOW AND TO BOTH SIDES OF DOOR HARDWARE. MOUNTING PLATE FOR CLOSER AND LOCKSET COORDINATION SHALL BE PROVIDED BY GATE MANUFACTURER. CARD READERS, DOOR POSITION SWITCH, AND POWER SUPPLY TO BE PROVIDED BY SECURITY CONTRACTOR.

AT ALL CAGES, THIS SET SHALL BE APPLIED ONLY TO PEDESTRIAN GATES. SLIDING GATES THAT LEAD INTO CAGES DO NOT REQUIRE ACCESS CONTROL OR ELECTRIFIED LOCKING HARDWARE.

Set: TI-26D
Doors: EMERGENCY EXIT ONLY DOUBLE CAGE DOOR
Description: CAGE DOOR | FUNCTION: NO EXTERIOR TRIM, EMERGENCY EXIT ONLY

6	Hinges	By gate manufacturer		OT
1	Fixed Mullion	By gate manufacturer		OT
2	Rim Exit Device (EO)	8810 EO	US32D	SA
2	Surface Closer	(P)7500	689	NO
2	Door Position Switch	By security contractor		OT
2	Gate Plate Kit	GTPL x GTSTKBKT x GTPLGRD		DX

Notes: FENCE MANUFACTURER SHALL PROVIDE MOUNTING PLATE FOR CLOSER. MOUNTING PLATE FOR CLOSER AND LOCKSET COORDINATION SHALL BE PROVIDED BY GATE MANUFACTURER. DOOR POSITION SWITCH TO BE PROVIDED BY SECURITY CONTRACTOR.

Set: TI-27
Doors: EGRESS CORRIDOR PAIR
Description: INTERIOR EGRESS | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

8	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
2	CVS Fire Exit HW (PASSAGE)	12 NB MD8615 ETP	US32D	SA
2	Surface Closer	(P)7500	689	NO
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Electromagnetic Holder	998M (intergate into bldg fire alarm sys)	689	RF
1	Gasketing	S88D		PE
2	Sweep	315CN		PE
1	Meeting Stile Seal	S772D		RF

Set: TI-28
Doors: STAIRWELL EGRESS CORRIDOR
Description: INTERIOR EGRESS | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Fire Exit HW (PASSAGE)	12 8815 ETP	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE
1	Sweep	315CN		PE

Set: TI-28A
Doors: STAIRWELL EGRESS CORRIDOR > 40” WIDE
Description: INTERIOR EGRESS | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

4	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Fire Exit HW (PASSAGE)	12 8815 ETP	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1	Floor Stop	446	US26D	RO
1	Gasketing	S88D		PE
1	Sweep	315CN		PE

Set: TI-29
Doors: SHOVEL CLOSET PAIR
Description: INTERIOR DOOR | FUNCTION: MECHANICAL LOCK, STOREROOM FUNCTION

6	Hinge	TA2714 NRP	US26D	MK
2	Manual Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	28 70 10G04 LP	US26D	SA
1	Permanent Keyed Core	By others	626	OT
2	Surf Overhead Hold Open	9-_6	652	RF
2	Surface Closer	(P)7500	689	NO
2	Armor Plate (PUSH SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Armor Plate (PULL SIDE)	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
2	Floor Stop	446	US26D	RO
2	Silencer	608-RKW		RO

Set: TI-30
Doors: EGRESS CORRIDOR SINGLE
Description: INTERIOR EGRESS | FUNCTION: EXTERIOR LEVER, PASSAGE FUNCTION

3	Hinge, Hvy Wt	T4A3786 NRP	US26D	MK
1	Rim Fire Exit HW(PASSAGE)	12 8915 ETP	US32D	SA
1	Surface Closer	(P)7500	689	NO
1	Armor Plate– Push Side	K1050 (-F) 34” H X 2” LDW CSK	US32D	RO
1	Armor Plate – Pull Side	K1050 (-F) 34” H X 1” LDW CSK	US32D	RO
1	Electromagnetic Holder	998 (tie into bldg fire alarm system)	689	RF
1	Gasketing	S88D		PE

1	Sweep	315CN	PE

Set: TI-31
Doors: TURNSTILE
Description: TANDUM FULL HEIGHT TURNSTILE | FUNCTION: FAIL SECURE INGRESS, FAIL SAFE EGRESS, FIRE ALARM RELAY INTEGRSTION REQUIRED

1	Hardware	Door Manufacturer	OT

Set: TI-31A
Doors: BOON EDAM SPEEDLANE TURNSTILE
Description: TANDUM FULL HEIGHT TURNSTILE | FUNCTION: FAIL SECURE INGRESS, FAIL SAFE EGRESS, FIRE ALARM RELAY INTEGRSTION REQUIRED

1	Hardware	Door Supplier	OT

Notes: ARCHITECT SHALL CONFIR LANE QUANTITIES

Set: TI-32
Doors: MAIN EMPLOYEE ENTRY WITH AUTOMATIC OPERATOR
Description: ALUMINUM STOREFRONT PAIR | FUNCTION: EXTERIOR PULL, PASSAGE FUNCTION

2	Continuous Hinge w/cutout	CFM__SLF-HD1		PE
2	Push Bars	47-PB	US32D	RO
2	Door Pull	BF157	US32D	RO
1	Automatic Door Operator	6061	689	NO*
1	Surface Door Closer (TOP JANB)	UNIJ7500	689	NO
1	Weatherseal	Door manufacturer		OT
2	Door Operator Switch	503		NO*

Notes: ALWAYS FREE EGRESS AND ENTRY. CONFIRM OPERATOR SWITCH MOUNTING LOCATION, MOUNTING REQUIREMENTS, AND SWITCH TYPE PRIOR TO ORDER. PROVIDE POWER TO DOOR OPERATOR AND COORDINATE ROUGH-IN REQUIREMENTS WITH E.C.

Set: TI-33
Doors: MAIN EMPLOYEE VESTIBULE PUSH/PULL
Description: ALUMINUM STROREFRONT PAIR | FUNCTION: EXTERIOR PULL, PASSAGE FUNCTION

2	Continuous Hinge w/cutout	CFM__SLF-HD1		PE
2	Push Bars	47-PB	US32D	RO
2	Door Pull	BF157	US32D	RO
2	Surface Closer	UNI7500	689	NO
2	Drop Plate	7788	689	NO

2	Blade Stop Spacer Kit	6190/6191 as required	689	NO
1	Weatherseal	Door manufacturer		OT

Notes: ALWAYS FREE EGRESS AND ENTRY.

Set: TI-34
Doors: SMOKER VESTIBULE
Description: ALUMINUM STOREFRONT SINGLE | FUNCTION: EXTERIOR PULL, PASSAGE FUNCTION

1	Continuous Hing w/cutout	CFM__SLF-HD1		PE
1	Push Bar	47-PB	US32D	RO
1	Door Pull	BF157	US32D	RO
1	Surface Closer	UNI7500	689	NO
1	Drop Plate	7788	689	NO
1	Blade Stop Spacer Kit	6190//6191 as required		OT
1	Weather seal	Door manufacturer		OT

Notes: ALWAYS FREE EGRESS AND ENTRY.

END OF SECTION 087100

SECTION 08 8000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 361 - Joint Sealers: Sealant and back-up material.

B. Section 08 1113 - HOLLOW METAL DOORS AND FRAMES: Glazed lites in doors and borrowed lites.

C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

D. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished by storefront manufacturer. Coordination of energy code compliance.

E. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished by storefront manufacturer. Coordination of energy code compliance.

F. Section 08 5113 - Aluminum Windows: Glazing furnished by window manufacturer.

G. Section 08 8717 - Safety and Security Glazing Films.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

D. ASTM C1036 - Standard Specification for Flat Glass.

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

I. GANA (GM) - GANA Glazing Manual.

J. GANA (SM) - GANA Sealant Manual.

K. NFRC - North American Fenestration Council: Energy Code compliance. Component Modeling Approach (CMA).

1.04 PERFORMANCE REQUIREMENTS

A. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures in accordance with the International Building Code.
   1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
   2. Limit glass deflection to 1/175 or 3/4 inch or flexure limit of glass, whichever is less, with full recovery of glazing materials.
   3. Thicknesses listed are minimum.

B. Exterior Assemblies Energy Ratings: Doucumentation that full assembly meets NFRC standards as described for this design including U-factor, solar heat gain coefficient, air leakage and visible transmittance.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

C. Samples: Submit two samples 12 x 12 inch in size of glass units, showing coloration and design.

D. Certificates: Certify that exterior and fire rated assemblies meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Type IG-1 - Sealed Insulating Glass Units: Vision glazing, with Low-E coating.
   1. Application: All exterior glazing unless otherwise indicated.
   2. Between-lite space filled with air.
   3. Thermal Resistance (U-Value): 0.29, nominal.
   4. Total Solar Heat Gain Coefficient: 0.25, nominal.
   5. Total Visible Light Transmittance: 34 percent to 37 percent.
   6. Basis of Design: Vitro/PPG Industries, Inc: www.vitroglazings.com/en-US/glass.aspx.
   7. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
      a. Low E Coating: Vitro/PPG Solarban 60 on # 2 surface, no coating on #3 surface.
      b. Tint: Solargray.
   8. Inboard Lite: Annealed float glass, 1/4 inch thick.
      a. Tint: Clear.
   9. Total Thickness: 1 inch.
   10. Substitution Procedures: See Section 01 6000 - Product Requirements.

B. Type IG-2 - Sealed Insulating Glass Units: Spandrel glazing.
   1. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
   2. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
      a. Opacifier: Elastomeric coating, on #4 surface.
      b. Opacifier Color: To match IG-1.
   3. Total Thickness: 1 inch.

C. Type IG-3 - Sealed Insulating Glass Units: Diffusion.
   1. Application: Exterior glazing where indicated. Assembly to match IG-1 with added diffusion.
   2. Inboard Lite:
      a. Diffusion: Acid etch on #3 surface.

2.02 GLAZING UNITS

A. Type S-1 - Single Vision Glazing:
   1. Application: All interior glazing unless otherwise indicated.
   2. Type: Annealed and fully tempered, as indicated on drawings float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 and 1/2 inch. as indicated on drawings.

B. Type S-3 - Single Safety Glazing: Non-fire-rated.
   1. Application: Provide this type of glazing in the following locations:
      a. Glazed lites in doors, except fire doors.

b. Glazed sidelights to doors, except in fire-rated walls and partitions.
c. Other locations required by applicable federal, state, and local codes and regulations.
d. Other locations indicated on the drawings.

2. Type: Fully tempered float glass as specified.
3. Tint: Clear.
4. Thickness: 1/4 inch.

2.03 EXTERIOR GLAZING ASSEMBLIES

A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
   2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
   3. Glass thicknesses listed are minimum.
   4. Exterior Assemblies Energy Ratings: Label units with doucumentation that full assembly meets NFRC standards as described for this design including U-factor, solar heat gain coefficient, air leakage and visible transmittance.

2.04 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless noted otherwise.
   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 Kind FT.
   3. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.

B. Fire-Resistance-Rated Composite Glazing: Multi-layer glazing UL- or WH-listed as fire-resistance-rated glazing and complying with 16 CFR 1201 test requirements for Category II without the use of a surface-applied film.
   1. Fire Rating: As indicated; tested as a wall, not as opening protection.
   2. Less than 100 square inches: Equal to Saftifirst, Superlite X-45/60/90: 3/4 inch, clear.
   3. Greater than 100 square inches: Equal to Saftifirst, SuperLite II-XLM 90: 1-3/8 inch, clear.
   4. Permanently label all assemblies with ratings.

2.05 SEALED INSULATING LAMINATED GLASS MATERIALS

A. Sealed Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Edge Spacers: Aluminum, bent and soldered corners.
   3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
   4. Purge interpane space with dry hermetic air.

2.06 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 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.07 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face. As required for energy code compliance.

C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; black color.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; Black color.

E. Glazing Clips: Manufacturer's standard type.

F. Speak-Thru: 5 inch diameter, stainless steel; equal to CRL SST5; www.crlaurence.com.

G. Fire Rated Trim Assemblies: Rated glazing manufacturer's standard to provide complete rated assembly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.

E. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.04 CLEANING

A. Remove glazing materials from finish surfaces.

B. Remove labels after Work is complete.

C. Wash all glass prior to Date of Substantial Completion using a mild detergent or glass cleaner, leaving glass clean and free of streaks.

3.05 PROTECTION

A. Remove and replace broken, cracked, chipped or otherwise damaged glazing materials prior to Date of Substantial Completion.

END OF SECTION

SECTION 08 8300
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.

1.02 REFERENCE STANDARDS

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test.

B. ASTM C1036 - Standard Specification for Flat Glass.

C. ASTM C1193 - Standard Guide for Use of Joint Sealants.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.

E. GANA (GM) - GANA Glazing Manual.

F. GANA (SM) - GANA Sealant Manual.

G. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q2 (general use mirrors); silvering, safety glazing protective backing, and quality requirements in compliance with ASTM C1503.
   1. Thickness: 1/4 inch.
   2. Size: As noted on drawings.
   3. Safety Backing: ANSI Z97.1, 16CFR1201 Category II compliant film laminated backing material.

2.02 ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

D. Mirror Attachment Accessories: Stainless steel J-profile channels.

E. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.

F. Rolled Formed Frame: One piece, roll-formed angle frame, stainless steel, Type 430, satin finish, with welded frame corners, ground and polished smooth.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to all floors identified in the contract documents as to receive the floor coverings, including:
   1. Resilient tile and sheet.
   2. Broadloom carpet.
   3. Carpet tile.
   4. Thin-set ceramic tile.
   5. Resilient flooring.

1.02 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

B. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

1.03 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics and method of installation.

B. 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.

1.04 QUALITY ASSURANCE

A. Contractor may perform adhesive and bond test with his own personnel or hire a testing agency.

1.05 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.

PART 2 PRODUCTS

2.01 MATERIALS

A. 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. Stauf USA, LLC; ERP-270 Perma-Seal: www.staufusa.com.
      b. ARDEX Engineered Cements; ARDEX MC RAPID or MC Ultra: www.ardexamericas.com.
      c. HPS North America, Schönox; EPA and EPA Rapid: www.hpsubfloors.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Examine exsiting conditions:
   1. Confirm conditions required for installation by coating and flooring manufacturer.

2. Do not apply coating to visibly damp or wet surface.

B. Mechanically prepare floor surface as recommended by coating manufacturer.

3.02 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.

3.03 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. Test in accordance with ASTM F1869.

C. 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.

D. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY 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. Test in accordance with ASTM F2170 Procedure A.

C. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

D. 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 any test value exceeds 75 percent relative humidity.

E. Report: Report the information required by the test method.

3.05 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.

3.06 PREPARATION FOR FLOORING

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.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum sheathing.

B. Cementitious backing board.

C. Gypsum wallboard.

D. Decorative moldings and reveals.

E. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 2100 - Thermal Insulation: Acoustic and thermal fiberglass batt insulation.

C. Section 09 2216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

A. ANSI A108.11> ANSI A108/A118/A136.1 - American National Standard for Interior of Cementitious Backer Units.

B. ANSI A118.9>ANSI A108/A118/A136.1 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.

E. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base.

F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

G. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

H. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.

I. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

J. GA-216 - Application and Finishing of Gypsum Panel Products.

K. UL (FRD) - Fire Resistance Directory.

1.04 SUBMITTALS

A. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

B. Installer proposed control joint locations.

1.05 QUALITY ASSURANCE

A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 BOARD MATERIALS

A. 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-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X or C board, UL or WH listed.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 5/8 inch.
   4. Paper-Faced Products:
      a. USG Corporation; Sheetrock Brand Gypsum Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Mold Resistant Wallboard: Moisture and mold-resistant gypsum core encased in moisture resistant papers.
   1. Application: At all interior surfaces of exterior walls.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness: 5/8 inch.
   4. Products:
      a. USG Corporation: Sheetrock Brand Gypsum Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Backing Board For Wet Areas:
   1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
   2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9>ANSI A108/A118/A136.1 or ASTM C1325.
      a. Thickness: 1/4 inch.
      b. Products:
         1) USG Corporation; Durock: www.usg.com.
         2) Substitutions: See Section 01 6000 - Product Requirements.

D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas, restroom walls, and janitor room walls.
   2. Type: Regular and Type X, in locations indicated.
   3. Type X Thickness: 5/8 inch.
   4. Regular Board Thickness: 5/8 inch.
   5. Edges: Tapered.
   6. Products:
      a. USG Corporation; Fiberock Aqua-Tough Interior Panels.
      b. Substitutions: See Section 01 6000 - 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. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
      b. Substitutions: See Section 01 6000 - Product Requirements.

F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing at ceilings, unless otherwise indicated.

2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
   a. Primed face for locations to recieve adhered roofing membrane.
3. Regular Board Thickness: 1/2 inch.
4. Edges: Square.
5. Glass Mat Faced Products:
   a. CertainTeed Corporation; GlasRoc Brand.
   b. Georgia-Pacific Gypsum; DensGlass Sheathing.
   c. National Gypsum Company; Gold Bond eXP Sheathing.
   d. Substitutions: See Section 01 6000 - Product Requirements.

G. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
   1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
   2. Products:
      a. USG Corporation; Sheetrock Gypsum Liner Panels.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Moldings and Reveals: Extruded aluminum drywall trim. Size and shape as indicated on the drawings.

B. 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 at exposed panel edges.

C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Ready-mixed vinyl-based joint compound.

D. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.

E. 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

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 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 Non-Rated: Install gypsum board vertical (parallel to framing), with ends and edges occurring over firm bearing.
   1. Stagger joints in drywall on opposite sides of metal studs.

C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

E. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11> ANSI A108/A118/A136.1 and manufacturer's instructions.

F. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

G. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.03 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Based on reviewed contractor's submittal of proposed joint locations based on ASTM C840/GA-216.
   2. Spaced not greater than 30 feet in either direction on walls and ceilings.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations indicated on the drawings. Provide vent area specified.

E. Moldings and Reveals: Install in accordance with manufacturer's instructions. All pieces shall be securely mounted to gypsum wallboard substrate and all joints shall be butted tight and finished smooth.

3.04 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. 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 is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.05 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 09 2216
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-load-bearing metal framing:
   1. Interior partitions, furring and soffits
   2. Interior suspended ceilings and soffits

B. Framing accessories.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Requirements for structural, exterior and interior load-bearing, exterior non-load-bearing, curtain wall, floor joist, roof rafter and truss, ceiling joist and shaft wall framing assemblies.

B. Section 06 1000 - Rough Carpentry: Wood blocking within stud framing.

C. Section 08 3100 - Access Doors and Panels.

D. Section 09 2116 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members.

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

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.

E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

G. SSMA - Product Technical Guide

1.04 SUBMITTALS

A. See Section 01 3000 - 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. Marino/WARE: www.marinoware.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Base framing design on the initial size and spacing as indicated on drawings.
   2. Structural Performance: Designate per manufacturer's standards, design of openings or other non-standard framing, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes. 5psf minimum lateral load.
   4. Live load deflection meeting the following, unless otherwise indicated:
      a. Interior Walls and Ceilings: Maximum horizontal deflection under wind load of 1/240 of span, typical, and 1/360 for assemblies with ceramic tile.
   5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated.
   1. Studs: C shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C shaped.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 (minimum),, for 33 and 43 mill members, Grade 50 for 54 mill or heavier with G60/Z180 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
      a. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1 1/2 inch. Confirm anticipated maximum deflection with structural documents.
      b. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet.
   4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

C. Tracks and Runners: Same material and thickness as studs or heavier per design requirements, bent leg retainer notched to receive studs .

D. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.

E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

F. Fasteners: ASTM C1002 self-piercing tapping screws.

G. Anchorage Devices: Power actuated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.

D. Align and secure top and bottom runners at 24 inches on center.

E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

F. Install studs vertically at spacing indicated on drawings.

G. Align stud web openings horizontally.

H. Secure studs to tracks using fastener method. Do not weld.

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. Brace stud framing system rigid.

L. Coordinate erection of studs with requirements of door frames; install supports and attachments.

M. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

N. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.03 CEILING AND SOFFIT FRAMING

A. Comply with requirements of ASTM C754.

B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

END OF SECTION

SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Ceramic trim.

D. Non-ceramic trim.

E. Tile setting materials and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section : 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

C. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).

B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for installing grouts and adhesives.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.

1.05 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

1.06 EXTRA MATERIALS

A. Provide 3 percent of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
   1. Provide products, sizes and layout as scheduled on Drawings.

B. Glazed Wall Tile: ANSI A137.1, and as follows:
   1. Moisture Absorption: 3.0 to 7.0 percent.
   2. Size and Shape: 4 x 4 inch, unless indicated otherwise on drawings.
   3. Edges: Cushioned.
   4. Surface Finish: High gloss.
   5. Color(s): As scheduled.
   6. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.

C. Porcelain Tile : ANSI A137.1, and as follows:
   1. Manufacturers:
      a. Provide products scheduled on Drawings.
   2. Moisture Absorption: 0 to 0.5 percent.

3. Size and Shape: 12 x 24 inch, unless indicated otherwise on drawings.
4. Thickness: 3/8 inch
5. Edges: Cushioned.
6. Surface Finish: As scheduled on the Drawings.
7. Color(s): As scheduled.
8. Trim Units: Matching cove base shapes in 6 x 12 inch size, unless indicated otherwise on drawings.

2.02 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching bullnose and cove base 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: As indicated on drawings, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Open edges of floor tile.
      b. Transition between floor finishes of different heights.
      c. Thresholds at door openings.
      d. Borders and other trim as indicated on drawings.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com/#sle.

2.03 SETTING MATERIALS

A. Manufacturers:
   1. Setting materials and grout by same manufacturer.
   2. Custom Building Products; ProLite: www.custombuildingproducts.com.
   3. Mapei; Ultralite: www.mapei.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
   1. Applications: Use this type of bond coat where indicated .

2.04 GROUTS

A. Manufacturers:
   1. Custom Building Products; Prism: www.custombuildingproducts.com.
   2. Mapei; Ultracolor Plus FA, as appropriate for assembly: www.mapei.com
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
   1. Applications: Use this type of grout where indicated .
   2. Use unsanded grout for all applications, 1/16 to 1/2 inch.
   3. Color(s): As selected by Architect from manufacturer's full line, as shown on drawings.

2.05 ACCESSORY MATERIALS

A. Elastomeric Membrane: Proprietary, fabric reinforced peel-and-stick waterproofing and crack suppressant membrane complying with ANSI A118.12, high performance.
   1. Custom Building Products; CrackBuster Pro, Waterproofing/Anti-fracture/Crack Suppressant, www.custombuildingproducts.com.
   2. Mapei; Mapeguard II: www.mapei.com
   3. Substitutions: See Section 01 6000 - Product Requirements.
   4. Thickness: 40 mils, maximum.
   5. Crack Resistance: No failure at 3/8 inch gap, minimum.
   6. Fiberglass mesh/tape at all concrete control joints and cracks.

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. Fluid or Trowel Applied Type:
      a. Material: Liquid-applied Elastomeric.
      b. Products:
         1) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
         2) Mapei; Mapelastic Aqua Defense: www.mapei.com
         3) Substitutions: See Section 01 6000 - Product Requirements.
      c. Extend waterproofing membrane up wall behind tile base.

C. Movement Joint Sealant: Specifically designed for all sealant joint conditions in TCNA EJ171, complying with ASTM C920.
   1. Material: Silicone Sealant
   2. Products:
      a. Custom Building Products; 100% Silicone Sealant: www.custombuildingproducts.com.
      b. Mapei; Mapesil: www.mapei.com
      c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 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.
   1. Tiles under 15 inch dimensions maximum 1/4 inch per 10 feet.
   2. Tiles over 15 inch dimensions maximum 1/8 inch per 10 feet.

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. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.

D. Verify that required floor-mounted utilities are in correct location.

3.02 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 crack isolatione membrane over control joints and cracks in floor slab in accordance with manufacturer's instructions. "Relocate" saw-cut control joints per TCNA F125 Partial Coverage.

3.03 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. 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.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive, per ASTM C1193.

I. Keep expansion joints free of adhesive or grout, per ASTM C1193. Apply sealant to joints.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated.

L. 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.

M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113 for slab on grade and F113A for suspended slabs, with standard bond coat and grout.
   1. Set tile on waterproofing membrane on all concrete slabs.
   2. Adhere to TCNA F125 - Partial to relocate saw-cut control joints.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C, using membrane at toilet rooms.

B. Over gypsum wallboard on studs, install in accordance with TCNA (HB) Method W243.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

C. Rigid Sound Attenuation Panels.

1.02 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.

B. 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.

C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on acoustical units.

C. Seismic Support and Design: Maufacturer's detailed design of any code required seismic support and bracing.

D. Samples: Submit two samples 4 by 4 inch in minimum size illustrating material and finish of acoustical units, provide for substitutions only.

1.04 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.

1.05 PROJECT CONDITIONS

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. Install acoustical units after interior wet work is dry.

1.06 EXTRA MATERIALS

A. See Section 01 6000 - Product Requirements, for additional provisions.

B. Furnish extra materials for Owner's future use, in full un-opened boxes, and identified with appropriate labels in the quantities listed below. Store as directed by Construction Manager.
   1. Acoustical Ceiling Units: Furnish quantity of full size units as follows:
      a. Type ACT-1: Two (2) boxes.
      b. All other types of tiles: One (1) box each.
   2. Exposed Suspension System Components: None.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Manufacturers:
   1. Armstrong World Industries, Inc: www.armstrong.com: Basis of Design.
   2. Certainteed: www.certainteed.com/commercial-ceilings:
   3. USG: www.usg.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Units - General: ASTM E1264, Class A.

C. Acoustical Panels: Painted mineral fiber,ASTM E1264 Type III, with the following characteristics:

1. Thickness: 5/8 inches.
2. Composition: Wet felted.
3. Edge: Square.
4. Surface Color: White.
5. Surface Pattern: Perforated, small holes.
6. ACT-1: 24 x 48
   a. Armstrong: Cortega #769
   b. Certainteed: Baroque - BET-197
   c. USG: Radar - 2310
7. ACT-3: 24 x 24
   a. Armstrong: Cortega #770
   b. Certainteed: Baroque - BET-157
   c. USG: Radar - 2110
8. ACT-4: 24 x 48, Fire Rated
   a. Armstrong: Cortega #823
   b. Certainteed: Baroque - PBT-197
   c. USG: Radar - 2315

D. Acoustical Panels: Vinyl faced mineral fiber, ASTM E1264 Type IV, with the following characteristics:
1. Thickness: 5/8 inches.
2. Composition: Wet felted.
3. Edge: Square.
4. Surface Color: White.
5. Surface Pattern: Smooth. No pattern.
6. ACT-2: 24 x 24, Clean Room, Unperforated
   a. Armstrong: Clean Room VL - #868
   b. Certainteed: Vinylshield A - 1102-CRF-1
   c. USG: Clean Room ClimaPlus - 56099

E. Acoustical Clouds:
1. Thickness: 5/8 inches.
2. Composition: Wet felted.
3. Edge: Tegular.
4. Surface Color: White.
5. Surface Pattern: Perforated, small holes.
6. ACT-5: 24 x 24
   a. Armstrong: Cortega #704
   b. Certainteed: Baroque - BET-154
   c. USG: Radar - 2120

2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
1. Same manufacturer as tiles.
2. Armstrong World Industries, Inc: www.armstrong.com: Basis of Design.

B. 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.
1. Hold Down Clips: Suspension system manufacturer's standard design compatible with ceiling panels specified and fire rating as required.
2. Hanger Wire: Minimum 12 gauge, galvanized, soft annealed, mild steel wire.
3. Hanger Rod: Minimum 1/4" diameter, threaded galvanized steel rod.
4. Hanger Strap: Minimum 3/16" thickness by 1" wide, galvanized steel strap for fixture support.
5. Wire Ties: Minimum 18 gauge, galvanized, annealed steel wire.

6. Hanger Clips: Prefabricated metal clamps for fastening to building structure.
7. Carrying Channels: 16 gauge, cold-rolled steel, 1-1/2" deep.

C. Exposed Steel Suspension System for ACT-1 and ACT-3: Formed steel, commercial quality cold rolled; intermediate-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish: White painted.
4. Products:
   a. Armstrong: Standard Prelude
   b. Certainteed: Classic Hook
   c. USG: Donn DX/DXL

D. Exposed Steel Suspension System for ACT-2 Clean Room: Formed steel, commercial quality cold rolled; intermediate-duty, integral gasket system.
1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish: White painted.
4. Product:
   a. Armstrong: Clean Room
   b. Certainteed: Clean Room STAB
   c. USG: Donn CE

E. Fire-Rated Exposed Steel Suspension System for ACT-4: Formed steel, commercial quality cold rolled; intermediate-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Finish: White painted.
3. Hold-down clips.
4. Product:
   a. Armstrong: Standard Prelude XL
   b. Certainteed: Classic STAB
   c. USG: Donn DX/DXL Fire Rated

F. Exposed Suspended Cloud System for ACT-5:
1. Edge Profile: 6 inch high
2. Field Profile: Tee; 15/16 inch wide face.
3. Construction: L Profile and Double web.
4. Finish: As indicated on drawings.
5. Products:
   a. Armstrong: Axiom Vector (inverted) for Formations at edge, and Standard Prelude in field.

2.03 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.

C. Acoustical Insulation: Specified in Section 07 2100.

D. Acoustical Sealant For Perimeter Moldings: Specified in Section 361.

2.04 RIGID SOUND ATTENUATION PANELS

A. Manufacturers:
1. F-SORB; Acoustical Panel Ceiling System: www.f-sorb.com (Basis of Design)
2. Acoustical Solutions, PolyPhon Acoustic Panels: www.acousticalsolutions.com
3. Autex Interior Acoustics, Quietspace Panel: www.autexacoustics.com
4. Substitutions: None.

B. Attneuation Panels - General: ASTM E1264, Class A.

C. Attenuation Panels: Solid color 100% polyester fiber with the following characteristics:
   1. Size: 48 by 96 inches.
   2. Thickness: 1 inch.
   3. NRC 0.75 to 0.85.
   4. Edge: Square
   5. Color: White.
   6. Suspension: 1 inch furring, either blocking or hat channel.

PART 3 EXECUTION

3.01 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C 636, ASTM E 580, 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.

3.02 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. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.

G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

H. Install hold-down clips on panels within 10 ft of an exterior door.

3.03 INSTALLATION - RIGID SOUND ATTENUATION PANELS

A. Locate system according to reflected ceiling plan.

B. Install units in accordance with manufacturer's instructions.

C. Cutting Acoustical Units: Make field cut edges of same profile as factory edges.

D. Fit units in place, free from damaged edges or other defects detrimental to appearance and function.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Install units using mechanical clips directly through blocking to decking, or to furring.

3.04 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 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.

D. ASTM F1861 - Standard Specification for Resilient Wall Base.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

1.05 FIELD CONDITIONS

A. Concrete Slab Curing Materials and Methods: Review concrete slab curing and sealing materials submittals provided by General Contractor for compatibility with adhesive materials provided under this Section. Notify General Contractor, in writing, of materials' compatibility or non-compatibility with adhesive materials provided under this Section. Proceed with installation only after compatible materials and/or curing methods have been approved, or non-compatible curing or sealing materials have been removed by the General Contractor.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. 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.

D. Prior to start of installation, test concrete for moisture content and adhesive bond as determined by flooring manufacturer's recommended moisture and bond tests.

1.06 EXTRA MATERIALS

A. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging appropriate labels in the quantities listed below. Store materials as directed by Owner.

1. VCT: One (1) box of each type and color.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.

1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
3. Size: 12 by 12 inch.
4. Thickness: 0.125 inch.
5. Color: As shown on drawings.
6. Product: Imperial Texture Standard Excelon manufactured by Armstrong Industries.

B. Luxury Vinyl Tile (LVT): Embossed surface vinyl tile
1. ASTM F1700 - Class III, Type B - Embossed
2. ASTM E648 - Passes - ≥ 0.45 watts/cm², Class 1
3. Thickness: 0.2 inch
4. Size: Nominal 9 inch wide by 59 inch long
5. Color: As shown on drawings.
6. Product: Lineate, manufactured by Mohawk Group.

2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TV, vinyl, thermoplastic; top set Style B, Cove.
1. Height: 4 inch and 6 inch as scheduled on the Drawings.
2. Thickness: 0.125 inch.
3. Finish: Satin.
4. Length: Roll.
5. Color: As scheduled on Drawings.
6. Accessories: Premolded external corners and internal corners.
7. Inside and Outside Corners: Job formed. Pre-molded corners only permitted where proper anchorage cannot be obtained.
8. Manufacturers:
   a. Johnsonite, a Tarkett Company: www.johnsonite.com.

2.03 ACCESSORIES

A. Adhesives: Adhesives used in interior locations must not emit more VOCs than 50 g/l for VCT and Subfloor Adhesives. Water-resistant stabilized type as recommended by flooring manufacturer or as indicated below.
1. VCT: Armstrong adhesive #S-700 or #S-515.
2. VCT High Moisture areas: Use Armstrong adhesive #S-240 in areas that are consistently wet.
3. LVT: M95.0 Resilient Flooring Adhesive, M99 Resilient Flooring Adhesive, or M700 Adhesive
4. Wall base adhesive: Johnsonite #960.

B. Trowelable Leveling and Patching Compounds: Products by TEC Inc. Equal products by Bostic, and Mapei or comparable materials recommended by flooring manufacturer for applications indicated are also acceptable.
1. Material: VersaPatch, latex modified patch and leveling compound.
2. Additive: Patch Additive 861.
3. Primer: Primer.

C. Moldings, Transition and Edge Strips: Vinyl. Product as scheduled on Drawings.

D. Protective Coat: "Revive Plus SC" Neutral Cleaner and "Vectra" Floor Finish by Johnson Wax Products.

PART 3 EXECUTION

3.01 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 09 0561.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

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. Clean substrate. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

F. Set flooring in place, press with heavy roller to attain full adhesion. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 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.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

C. Cut tile neatly around all fixtures. Broken, cracked, chipped or deformed tile are not acceptable.

3.05 INSTALLATION - RESILIENT BASE

A. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

B. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

C. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units. Shave back of base where necessary to produce a snug fit to substrate.

D. Install base on solid backing. Bond tightly to wall and floor surfaces.

E. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.07 INITIAL MAINTENANCE:

A. Clean resilient flooring not more than 4 days before date scheduled for inspections intended to establish date of substantial completion in each area of project.

B. Apply two (2) coats of tile manufacturers recommended high-quality commercial floor polish.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION

SECTION 09 6566
RESILIENT RUBBER FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rubber tile, adhesively installed.

B. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

B. Section 09 6500 - Resilient Flooring.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed data sheets for products specified.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer certified in writing by the flooring manufacturer to be qualified for installation of specified flooring system.

1.06 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.

1.07 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

2.01 PREFORMED RUBBER FLOORING

A. Manufacturers: All products by the same manufacturer.
   1. Ecore, Distributed by Centaur: Speckled S, Rubber Fitness Flooring.
   2. Roppe Corporation: www.roppe.com; Recoil Fitness Flooring.
   3. Substitutions: Not permitted.

B. Rubber Sheet Flooring: Recycled rubber tires and colored EPDM granules with urethane binder, lengths to avoid transverse seams.
   1. Thickness: 8 mm
   2. Thickness: Minimum 3/8 inch.
   3. Sheet Width: Minimum 48 inches.
   4. Installation: Adhesive
   5. Color: As indicated.

C. Rubber Tile Flooring: Recycled rubber tires and colored EPDM granules with urethane binder, formed into square tiles.
   1. Thickness: Minimum 3/8 inch.
   2. Size: Nominal 36 inch square.
   3. Tile Edge/Installation: Straight, adhesive installation.
   4. Color: As indicated.

2.02 ACCESSORIES

A. Leveling Compound: Latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.

B. Adhesive: Water-resistant type recommended by flooring manufacturer for project conditions.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

C. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Comply with manufacturer's recommendations.

C. Rubber Tile Flooring:
   1. Lay out center lines in spaces to receive tile flooring, based on location of principal walls. Start tile installation from center, and adjust as necessary to avoid tiles less than one-half width at perimeter.
   2. Lay tiles square with room axis, matching for color and pattern by selecting from cartons and mixing as recommended by manufacturer.
   3. Spread only enough adhesive to permit installation of materials before initial set.

3.04 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.05 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 09 6700
FLUID-APPLIED FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied flooring.

B. Divider strips and accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation.

B. Section 09 9123 - Interior Painting: Epoxy paints or coatings on surfaces other than floors.

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

1.04 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available .

B. Samples: Submit three samples, 4 x 6 inch in size illustrating color and pattern for each floor material for each color specified.

C. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 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. Minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Deliver materials in original containers with seals unbroken and labels intact.

C. Store resin materials in a dry, secure area.

D. Store materials for three days prior to installation in area of installation to achieve temperature stability.

E. Comply with applicable health and fire regulations.

1.07 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F.

B. Store materials in area of installation for minimum period of 48 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 48 hours prior to, during, and 72 hours after installation of materials.

1.08 WARRANTY:

A. Provide two year warranty under provisions of Section 01 7000.

B. Warranty: Include coverage against flooring delamination from substrate and degradation of surface finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Flooring:
   1. Sherwin Williams: General Polymers: Basis of Design.
      a. Epoxy, two component, chemical resistant, colored.
      b. Base Coat: 3579 Standard Epoxy Primer/Binder, 5 to 6 mils dry film thickness.

c. Top Coat: 4638 HS Polyurethane Floor Enamel, 3 mils dry film thickness.
d. Capable of resisting spills containing up to 20% solution of sulphuric acid without damage to coating.
e. Color: As indicated on drawings
f. Slip Resistance Aggregate:
   1) Scrubber Dump 23 mils
   2) All other locations 12 mils

2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Control/Expansion Joint Filler: as recommended by manufacturer.

B. Floor Strips: Furnish where flooring does not teminate at a wall.

C. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

D. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 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 flooring.

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 flooring.

C. 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.

D. Do not proceed with surface preparation or coating applications until conditions are suitable. If test results.

E. Beginning of installation means acceptance of existing surfaces and substrate.

3.02 PREPARATION

A. Adhere to manufacturer's stated floor preparation.

B. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.

D. Vacuum clean substrate.

3.03 INSTALLATION - STRIPS

A. Accurately saw cut substrate to install divider strips.

B. Install strips straight and level to locations indicated.

C. Install fillet strips at base of walls where flooring is to be extended up wall as base.

3.04 INSTALLATION - FLOORING

A. Apply in accordance with manufacturer's instructions.

B. Apply each coat to minimum thickness required by manufacturer.

3.05 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

END OF SECTION

SECTION 09 6800
CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet, direct-glued.

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.

B. Section 09 3000 - Tiling: Trims

C. Section 09 6519 - Resilient Tile Flooring - Metroflor: Base and trims

D. Section 09 6813 - Tile Carpeting.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute.

1.04 SUBMITTALS

A. See Section 01 3000 - 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. Samples: Submit two samples 9 by 9 inch minimum in size illustrating color and pattern for each carpet material specified.

D. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.

C. Ventilate installation area during installation and for 72 hours after installation.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet: Full-widths rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Carpet:
   1. As shown on drawings.
   2. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.

2.02 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Underlayment products by TEC Inc. Comparable products by Bostik and Mapei, or materials recommended by carpet manufacturer are also acceptable.
   1. Material: VersaPatch, latex modified patch and leveling compound.
   2. Additive: Patch Additive 861.
   3. Primer: Primer.

B. Installation Adhesive: Direct glue down method with solvent free and VOC (Volatile Organic Compounds) free adhesives as recommended for the purpose by the manufacturer for the selected carpet and approved by the General Contractor. Adhesives used for carpet must not emit more VOCs than 50 g/l.

C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.

D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

E. Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber of size and profile indicated. See Section 09 6500 for transition strips.

PART 3 EXECUTION

3.01 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 carpet.

B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesives to sub floor surfaces.

C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

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. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install carpet in accordance with manufacturer's instructions and CRI Carpet Installation Standard.

C. Verify carpet match before cutting to ensure minimal variation between dye lots.

D. Lay out carpet and locate seams in accordance with shop drawings.
   1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
   2. Do not locate seams perpendicular through door openings.
   3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
   4. Locate change of color or pattern between rooms under door centerline.
   5. Provide monolithic color, pattern, and texture match within any one area.

E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

F. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves and similar openings.

3.04 DIRECT-GLUED CARPET

A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.

B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.

C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.

D. Roll with appropriate roller for complete contact of adhesive to carpet backing.

E. Trim carpet neatly at walls and around interruptions.

3.05 CLEANING

A. Remove excess adhesive from floor and wall surfaces without damage.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, loose laid with edges and control grid adhered with polyester backed adhesive squares.

1.02 RELATED REQUIREMENTS

A. Section 09 0561: Common Work Results for Flooring Preparation:

B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.

C. Section 09 3000 - Tiling: Trims

D. Section 09 6519 - Resilient Tile Flooring - Metroflor: Base and trims

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.

B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute.

C. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute.

D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.04 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

1.05 EXTRA MATERIALS

A. Provide two boxes of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. As shown on drawings.

2.02 MATERIALS

A. Carpet Tile: As scheduled on Drawings, manufactured in one color dye lot.
   1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.

2.03 ACCESSORIES

A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Adhesive Strips: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.01 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 sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

C. 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 09 0561.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 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.

3.03 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. LokDots shall be used to secure tile to floor. Place LokDot under each corner of tile as recommended by the manufacturer.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 7733
GLASS FIBER REINFORCED PLASTIC PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass fiber reinforced plastic panels.

B. Trim.

1.02 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. FM 4880 - Approval Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials.

1.03 SUBMITTALS

A. See Section 01 3000 - 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.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glass Fiber Reinforced Plastic Panels:
   1. Crane Composites, Inc; (Kemlite): www.cranecomposites.com; Glasbord FXE
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 8 feet.
   2. Panel Thickness: 0.09 inch.
   3. Surface Design: Embossed.
   4. Color: White.
   5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

A. Panels: Glass fiber reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   2. Class 1 fire rated when tested in accordance with FM 4880.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer, low VOC.

D. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Pre-drill fastener holes in panels, 1/8 inch greater in diameter than fastener, spaced as indicated by panel manufacturer.

D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

F. Install panels with manufacturer's recommended gap for panel field and corner joints.

G. Place trim on panel before fastening edges, as required.

H. Fill channels in trim with sealant before attaching to panel.

I. Install trim with adhesive and screws or nails, as required.

J. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

K. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 09 9035
TEXTURED COATINGS

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. Textured coating on exterior concrete wall surfaces and light pole bases.

B. Preparation of of concrete wall panels.

1.02 RELATED WORK:

A. Section 03 3000 - Cast-in-Place Concrete.

B. Section 03 4100 - Precast Structural Concrete.

C. Section 03 4713 - Tilt-Up Concrete.

D. Section 09 9113 - Exterior Painting.

1.03 REFERENCE STANDARDS:

A. ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings; 2013.

B. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint; 2002 (Reapproved 2009).

C. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2005 (Reapproved 2010).

D. ASTM D2243 - Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings; 1995 (Reapproved 2014).

E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity; 2011.

F. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry; 2003 (Reapproved 2013).

G. ASTM E-84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

1.04 QUALITY ASSURANCE:

A. Product Manufacturer: Company specializing in the manufacturing of quality textured coating products with a minimum of 10 years experience.

B. Application: Company specializing in commercial application with 3 years experience on projects of similar scope.

1.05 REGULATORY REQUIREMENTS:

A. Comply with applicable city, county, state and federal requirements and ordinances regarding maximum V.O.C. (Volatile Organic Compound) content.

B. Conform to applicable building code for flame/fuel/smoke rating requirements for finishes.

C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.06 PROJECT CONDITIONS

A. Water based products are preferred. Contractor to submit solvent based products only if required by environmental conditions indicated in the project schedule.

1.07 SUBMITTALS:

A. Submit product data for specified products under provisions of Section 01 3000. Include all performance and physical data.

B. Submit letter from manufacturer indicating system application to pass the wind driven rain test, including the primer and number of coats to provide dry film thickness required.

C. Submit manufacturer's installation instructions under provisions of Section 01 3000.

D. Submit letter confirming applicators qualifications.

E. Submit minimum 2 samples 8 x 8 inches in size of material applied to appropriate substrate.

F. Submit from manufacturer 3 copies of sample warranty and letter stating intent to provide 5 year warranty.

1.08 MOCK-UP PANELS:

A. At a location approved by Architect, paint one full size concrete wall panel with all base colors and accent stripes. This process may be repeated up to 3 more times (using adjacent panels) at no additional cost to Owner.

B. Accepted mock-up may be included as part of final work.

1.09 ENVIRONMENTAL REQUIREMENTS:

A. Maintain ambient temperature as required by manufacturer for application system.

B. Provide adequate ventilation during application.

C. Provide adequate illumination.

D. Restrict traffic from area where coating is being applied or is curing.

1.10 DELIVERY STORAGE AND HANDLING:

A. Deliver products to site under provisions of Section 01 6000.

B. Deliver materials in original containers with seals unbroken and labels intact.

C. Store materials and equipment in a protected, climate controlled area of project site.

D. Comply with applicable health and fire regulations.

E. Store materials at ambient temperatures as directed by manufacturer for each product in system, in well ventilated area.

1.11 SCAFFOLDS AND PROTECTION:

A. Provide adequate, safe ladders, scaffolds and stages necessary to complete work.

B. Protect completed finish coating work and adjacent finish surfaces from coating splatter, spills and stains. Use adequate drop cloths and masking procedures during progress of work.

1.12 WARRANTY:

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's 5 year written warranty for material replacement only due to chipping, flaking, peeling, delamination or blistering of coating from the underlying surface.

1.13 EXTRA MATERIALS:

A. Provide five extra gallons of each color of material used.

PART 2 - PRODUCTS

2.01 TEXTURED COATINGS

A. Provide high-build, weather resistant coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
   1. Wind Driven Rain Resistance: Dry film thickness and number of coats in system required to pass when tested according to ASTM D6904 at 98 miles per hour for 24 hours.
   2. Water Vapor Transmission: ASTM E96/E96M; 17 perms, maximum.

2.02 ACCEPTABLE PRODUCTS:

A. Water Based Acrylic:
   1. Textured Coatings of America:
      a. Primer: XL-70 "W" Primer (Water-based).
      b. Finish Coat: Tex-Cote 300 Textured Coating – Course Texture.
      c. Accent Color: DF Color-Cote Dead Flat.

2. Sherwin Williams:
    a. Primer: Loxon Concrete & Masonry Primer A24W 8300 Series.
    b. Finish Coat: ConFlex UltraCrete – Medium Texture CF17W0811.
    c. Accent Color: Loxon Acrylic Coating A24W300 Series
3. PPG Paints:
    a. Primer: 4-603 Perma-Crete Interior/Exterior Alkali Resistant Primer.
    b. Finish Coat: 4-60 Perma-Crete Texture Coating – Medium Texture.
    c. Accent Color: 4-22/4-30 Perma-Crete High Build Acrylic Topcoat.

B. Solvent Based Acrylic (Only to be used when environmental conditions preclude the use of water based products):
1. Textured Coatings of America:
    a. Primer: XL 70 Primer (Solvent).
    b. Finish Coat: Tex-Cote – XL 70 Textured Coating – Course Texture.
    c. Accent Color: Tex-Cote – XL 70 – Textured Coating – Smooth Texture.
2. Sherwin Williams:
    a. Primer: UltraCrete Solvent Borne – Smooth Texture B46W00850/53 Series.
    b. Finish Coat: Conflex UltraCrete Solvent Borne – Medium Texture CF18W0810
    c. Accent Color: Conflex UltraCrete Solvent Borne – Smooth Texture CF18W0850 Series.

2.03 MATERIALS:

A. Materials shall be pre-mixed.

B. Coverage:
1. Apply as required by manufacturer's system to meet specification.
2. Additional coats may be required for uniform textured or color appearance.

C. Color: Custom colors as selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. See concrete wall specification section for surface preparation and repair of minor defects in concrete wall panels.

B. Examine surfaces scheduled to receive coating for conditions that will adversely affect execution, perseverance, or quality of finish work, and which cannot be put into an acceptable condition through normal preparatory work. Notify Architect in writing of such unacceptable conditions.

C. Do not proceed with surface preparation or coating applications until conditions are suitable.

D. Application of coating or finish to surfaces shall constitute acceptance of that surface.

3.02 PREPARATION:

A. Clean surfaces which affect work of this section.

B. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust.

C. Shop Primed Steel 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.

D. Concrete: Chip or grind off all defective materials and foreign matter. Remove form treatment residue, curing compound, scum and fungus. Repair cracks, breaks, honeycombing, or other surface imperfections with non-expansive patching mortar to attain a finish comparable to adjacent concrete surface.

E. Pressure wash exterior face of concrete surfaces to be coated. Comply with manufacturer's recommendations for cleaning solutions to be used.

3.03 APPLICATION:

A. The intent of these specifications is to produce the highest quality appearance coating and finish surfaces. Employ skilled mechanics only. Comply with manufacturer's printed specifications for application. Allow repairs to properly cure before beginning installation.

B. Do not apply coatings while surface is damp, or during cold, rainy, or frosty weather, or when temperature is below 40 degrees F nor under conditions where temperature may drop below 40 degrees F within 24 hours after application, or as directed by manufacturer's documentation.

C. Spray apply mixture to required thickness.

D. Ensure that finished surfaces are uniform in texture, color, and thickness without noticeable "overlap" marks, or streaky appearance.

E. Utilize application equipment specifically recommended by coating manufacturer.

F. The number of coats specified are minimum. At no extra charge to Owner, additional coats shall be provided to achieve color and appearance uniformity.

G. Manufacturer's technical representative shall visit job-site for review and approval of mock-up sample. Do not proceed with work until manufacturer and Architect provide written acceptance of mock-up.

3.04 PROTECTION:

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and other protective coverings to prevent spray or drippings from disfiguring other surfaces.

D. Remove empty containers from site.

3.05 CLEANING/TOUCH-UP:

A. As work proceeds, promptly remove coating where spilled, splashed, or spattered.

B. During progress of work, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect waste, cloths, and material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

D. Spot touch-up will be allowed to correct soiled or damaged surfaces only when spot will blend into surrounding finish and is invisible to normal viewing. Otherwise recoat entire section to nearest corners or visible stopping point.

END OF SECTION

SECTION 09 9113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 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.

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Shop-primed items.

B. Section 09 9035 - Textured Coatings: Exterior concrete textured coating.

C. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

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

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

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

E. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1.

F. SSPC-SP 1 - Solvent Cleaning.

G. SSPC-SP 13 - Surface Preparation of Concrete.

1.04 SUBMITTALS

A. See Section 01 3000 - 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 Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - 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.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.06 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.

1.07 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. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

B. Provide paints and finishes from the same manufacturer.

C. Paints:
   1. Benjamin Moore: www.benjaminmoore.com.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

D. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required 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. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Architectural coatings VOC limits of the State in which the Project is located.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete and concrete masonry units.
   1. Two top coats and one coat filler/primer.

2. Filler/Primer:
    a. Benjamin Moore: 285 Super Craft Latex Block Filler.
    b. PPG: 6-7 Speedhide Latex Block
    c. Sherwin Williams: B25W25 PrepRite Acrylic Latex Block Filler.
3. Top Coat(s): Exterior Latex.
    a. Benjamin Moore: 183 Moorcraft Super Spec 100% Acrylic Flat House Paint.
    b. PPG Paints Speedhide Exterior Latex Flat, 6-610XI Series. (MPI #10).
    c. Sherwin Williams: A-100 A6 Acrylic Flat House Paint.

B. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
2. Gloss: Two coats of alkyd enamel.
    a. Benjamin Moore: M22 I.M.C. Urethane Alkyd Gloss Enamel
    b. PPG: 7-282 Pittsburgh Paints Industrial Oil Gloss
    c. Sherwin Williams: B54Z Industrial Alkyd Gloss Enamel

C. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
    a. Benjamin Moore: MO7 I.M.C. Universal Alkyd Metal Primer
    b. PPG: 90-712 Pitt-Tech Acrylic Metal Primer
    c. Sherwin Williams: B50WZ3 Galvite Galvanized Metal Primer
2. Gloss: Two coats of alkyd enamel.
    a. Benjamin Moore: 133 Impervo Alkyd High Gloss Enamel
    b. PPG: 7-282 Pittsburgh Paints Industrial Oil Gloss
    c. Sherwin Williams: B54Z Industrial Alkyd Gloss Enamel

2.04 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

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. 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. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
2. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. 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.

G. 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.

H. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

I. 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.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Apply paint, enamel, stain and varnish with suitable brushes, rollers or spraying equipment.
1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved.
2. Keep brushes and rollers and spraying equipment clean, dry, free from contaminates and suitable for the finish required.
3. Apply stain by brush.

G. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.

H. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

I. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

J. Change colors at corner of stop where colors differ between adjoining spaces or rooms and where door frames match wall colors.

K. Finish all edges of exterior doors same as faces.

L. The number of coats specified are minimum. The Contractor shall provide at no additional cost to the Owner, as many coats as necessary for color coverage conformity and uniform appearance.

M. Sand wood and metal surfaces lightly between coats to achieve required finish.

N. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

A. 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. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Structural steel roof framing, joists, and bridging
   10. Piping, conduit, and ductwork unless specifically noted
   11. Galvanized exterior stairs and railings
   12. Prefinished wood doors

B. Exterior Surfaces to be painted:
   1. All hollow metal doors and frames.
   2. Dock edge angles.
   3. All exposed piping.
   4. Gas piping on roof.
   5. Downspout guards.
   6. Smokers Canopy columns
   7. Exterior wheel stops
   8. Light pole bases
   9. Exterior sign poles
   10. Exterior bollards
   11. All other exposed metal except prefinished items.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 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.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 05 5000 - Metal Fabrications: Shop-primed items.

C. Section 05 5100 - Metal Stairs: Shop-primed items.

D. Section 09 9113 - Exterior Painting.

E. Section 09 6700 - Fluid-Applied Flooring

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.

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

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

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

E. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1.

F. SSPC-SP 1 - Solvent Cleaning.

G. SSPC-SP 13 - Surface Preparation of Concrete.

1.04 SUBMITTALS

A. See Section 01 3000 - 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 Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - 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.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.06 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.

1.07 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. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer.

B. Paints:
   1. Benjamin Moore: www.benjaminmoore.com
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.02 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. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Architectural coatings VOC limits of the State in which the Project is located.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - INTERIOR

A. Concrete Walls, Opaque, Latex
   1. One top coat and one coat primer.
   2. Primer:

a. Benjamin Moore: Ultra Spec 500 Latex Primer, N534
b. PPG: 6-2 Speedhide Latex Primer Sealer
c. Sherwin Williams: Loxon Masony Primer, LX02W0050

3. Top Coat(s):
a. Benjamin Moore: Ultra Spec 500 Latex, N536, Flat
b. PPG: 6-70 Speedhide Interior Latex Flat Wall Paint
c. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex, Flat

B. Concrete Walls, Opaque, Waterborne Epoxy
1. Two top coats.
2. Top Coat(s):
a. Benjamin Moore: Corotech Pre-Catalyzed Waterborne Epoxy, V341, Semi-Gloss
b. PPG: 16-510C Pitt-Glaze WB1 Pre-Catalyzed Acrylic Semi Gloss Epoxy
c. Sherwin-Williams: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-1150 Semi-Gloss

C. Concrete Masonry Walls, Opaque, Latex
1. Two top coats and one coat primer.
2. Filler/Primer:
a. Benjamin Moore: Ultra Spec 500 Latex Primer, N534
b. PPG: PPG 6-7 Speedhide Acrylic Latex Block Filler
c. Sherwin Williams: S-W Loxon Acrylic Masonry Primer, A24W8300

3. Top Coat(s):
a. Benjamin Moore: Ultra Spec 500 Latex, N536, Flat
b. PPG: 6-70 Speedhide Interior Latex Flat Wall Paint
c. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex, Flat

D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services, including shop primed steel deck, structural steel, metal fabrications, and galvanized ducts, one coat.
1. Top Coat: Latex Dry Fall, Flat.
a. Benjamin Moore: Latex Dry Fall - Flat, 395
b. PPG: 6-725XI Speedhide SuperTech WB Interior Flat Dry Fog
c. Sherwin Williams: PRO Waterborne Acrylic Dryfall

E. Paint I-OP-FL - Concrete Floor Striping to be Painted.
1. Two top coats without primer.
2. Top Coats without primer: Eopxy Mastic.
a. Products:
1) Sherwin-Williams Macropoxy 646, fast cure epoxy mastic
2) Substitutions: Section 01 6000 - Product Requirements.

F. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up Primer:
a. Benjamin Moore: Ultra Spec HP. Acrylic Metal Primer, HP04
b. PPG: 90-712 Pitt Tech DTM Acrylic Metal Primer
c. Sherwin Williams: B66-1310 Series Pro Industrial ProCryl Universal Primer

2. Semi-gloss Top coats:
a. Benjamin Moore: Ultra Spec HP DTM 100% Acrylic Semi-Gloss, HP29
b. PPG: 7-374 Pittsburgh Paints Semi Gloss Acrylic Metal Finish
c. Sherwin Williams: B66-600 Pro Industrial 0 VOC Acrylic Semi-Gloss

G. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. Primer:
a. Benjamin Moore: Ultra Spec HP. Acrylic Metal Primer, HP04
b. PPG: 90-712 Pitt Tech DTM Acrylic Metal Primer
c. Sherwin Williams: B66-310 Series Pro Industrial ProCryl Universal Primer

2. Semi-gloss Top coats:
a. Benjamin Moore: Ultra Spec HP DTM 100% Acrylic Semi-Gloss, HP29

b. PPG: 7-374 Pittsburgh Paints Semi Gloss Acrylic Metal Finish
c. Sherwin Williams: B66-600 Pro Industrial 0 VOC Acrylic Semi-Gloss

H. Paint GI-OP-3A - Gypsum Board/Plaster, Alkyd, 3 Coat:
1. One coat of latex primer sealer.
a. Benjamin Moore: Ultra Spec 500 Interior Primer, N534
b. PPG: 6-2 Speedhide Latex Primer Sealer
c. Sherwin Williams: B28W200 Prep-Rite 200 Latex Primer
2. Eggshell: Two coats of latex-acrylic enamel; .
a. Benjamin Moore: Ultra Spec 500 Latex Eggshell, N538
b. PPG: 6-411 Speedhide Latex Eggshell Enamel
c. Sherwin Williams: B20W2251 ProMar 200 Acrylic Latex Eggshell Enamel

I. Electrical Room Mounting Boards, Fire Retardant Latex, 2 Coat:
1. Two coats as required for full coverage.
a. Benjamin Moore: INSUL-X HP Fire Retardant Paint FR-210
b. PPG: 42-7 Speedhide Interior Fire Retardant Flat Latex.
c. Sherwin Williams: Flame Control Coatings Canada, Ltd.: Flame Control No. 20-20A.

2.04 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

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. 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. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. 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.

G. 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.

H. 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.

I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

J. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

K. 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.

L. 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.

M. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Apply paint, enamel, stain and varnish with suitable brushes, rollers or spraying equipment.
   1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved.
   2. Keep brushes and rollers and spraying equipment clean, dry, free from contaminates and suitable for the finish required.
   3. Apply stain by brush.

H. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.

I. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

J. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

K. Change colors at corner of stop where colors differ between adjoining spaces or rooms and where door frames match wall colors.

L. The number of coats specified are minimum. The Contractor shall provide at no additional cost to the Owner, as many coats as necessary for color coverage conformity and uniform appearance.

M. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

N. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

O. Apply dry erase coating per manufacturer's direction.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

A. 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. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Structural steel roof framing, joists, and bridging
   10. Piping, conduit, and ductwork unless specifically noted
   11. Galvanized exterior stairs and railings
   12. Prefinished wood doors

B. Interior Surfaces to be painted:
   1. All walls scheduled for paint
   2. Interior concrete wall panels scheduled to be painted
   3. All hollow metal doors and frames.
   4. Structural steel columns and structural steel braces shall be painted as indicated in drawings.
   5. Bollards
   6. Ladders, safety cages.
   7. Stairs and railings
   8. Guardrails.
   9. Dock edge angles
   10. Sprinkler risers up to the turn out at ceiling level.
   11. Exposed ductwork where indicated on Drawings

C. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

END OF SECTION

SECTION 10 1400
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building signage.

1.02 RELATED REQUIREMENTS

A. Section 01 2100 - Allowances: Signage allowance for tenant building identification.

1.03 REFERENCE STANDARDS

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

B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

1.04 SUBMITTALS

A. See Section 01 3000 - 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 name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. Submit for approval by Owner through Architect prior to fabrication.

D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

PART 2 PRODUCTS

2.01 SIGNAGE AND GRAPHICS

A. See drawings for full signage and graphics information, types of signs may include:
   1. Interior Room Signs
   2. Exit Signs
   3. Floor Loading Signs (Mezzanines)
   4. Maximum Occupancy Signs (ex. A3 Use Group)
   5. Stair Identification
   6. Stairwell Identification
   7. Elevator Emergency
   8. Drinking Fountain
   9. Areas of Refuge
   10. Areas of Assisted Rescue
   11. Two-Way Communication
   12. Informational signs

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs where indicated:
   1. If no location is indicated obtain Owner's instructions.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.13
METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal toilet compartments.

B. Urinal screens.

1.02 RELATED REQUIREMENTS

A. Section 10 2800 - Toilet Accessories.

1.03 REFERENCE STANDARDS

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

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.04 SUBMITTALS

A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Samples: Submit two samples of partition metal panels, 2 X 2 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Toilet Compartments:
   1. General Partitions Mfg. Corp; www.generalpartitions.com
   2. Sanymetal; www.sanymetal.com
   3. Bradley Corp - Mills Partitions; www.bradleycorp.com
   4. ASI - Accurate Partitions; www.accuratepartitions.com
   5. ASI - Global Partitions; www.asi-globalpartitions.com
   6. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

2.03 COMPONENTS

A. Toilet Compartments: Powder coated steel, floor-mounted headrail-braced.

B. Doors, Panels, and Pilasters: Sheet steel faces, pressure bonded to sound deadening core, formed and closed edges; corners made with corner clips or mitered, welded, and ground smooth.
   1. Panel Faces: 20 gage, 0.0359 inch.
   2. Door Faces: 22 gage, 0.0299 inch.
   3. Pilaster Faces: 20 gage, 0.0359 inch.
   4. Reinforcement: 12 gage, 0.1046 inch.
   5. Internal Reinforcement: Provide in areas of attached hardware and fittings. Mark locations of reinforcement for partition mounted washroom accessories.

C. Door and Panel Dimensions:
   1. Thickness: 1 inch.
   2. Door Width: 24 inch.
   3. Door Width for Handicapped Use: 36 inch, out-swinging.
   4. Height: 58 inch.

D. Pilasters: 1-1/4 inch thick, of sizes required to suit compartment width and spacing.

E. Urinal Screens: Wall mounted with continuous full height U-bracket.
   1. Width: 24 inch
   2. Height: 48 inch

2.04 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow anodized aluminum tube, 1 by 1-5/8 inch size, with anti-grip strips and cast socket wall brackets. Provide caps at any visible ends.

C. Wall Brackets: Continuous type full height of panel, Satin stainless steel.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.

E. Hardware: Satin stainless steel:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Thumb turn or sliding door latch with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull for outswinging doors, both sides.
   6. Wall mounted door stop at outswing doors flanking a wall.

F. Privacy Filler Strip: Continuous stop and hinge side filler strips to eliminate sightlines into compartments, surface applied rigid trim with flexible seal to cover gaps between panels.

2.05 FINISHING

A. Powder Coated Steel Compartments: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat and two finish coats powder coat enamel.

B. Color: As selected by Architect from manufacturers standard selection. See finish schedule on drawings for basis of design.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 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 enamel finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 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.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 2123
CUBICLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface mounted overhead metal curtain track and guides.

B. Curtains.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports for track.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for curtain fabric characteristics.

C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.

D. Samples: Submit 12 by 12 inch sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement, bottom weight, and carrier attachment to curtain header.

E. Samples: Submit 12 inch sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.

F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Curtains: Two of each type and size.
   3. Extra Carriers: Ten.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept curtain materials on site and inspect for damage.

B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cubicle Track and Curtains:
   1. A. R. Nelson Co; Product 1200: www.arnelson.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRACKS AND TRACK COMPONENTS

A. Track: Extruded aluminum sections; one piece per cubicle track run; dual channel profile.
   1. Finish on Exposed Surfaces: Satin finish.
   2. Products:
      a. Nelson Surface Mounted Cubicle Track with Roller 12.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Curtain Carriers: Nylon slider to accurately fit track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal; 3 carriers per foot of track length.

C. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.03 CURTAINS

A. Curtain Materials:
   1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   2. Naturally flame resistant or flameproofed; capable of passing NFPA 701 test.
   3. Curtain: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
   4. Curtain: Nelson Oxford Cloth Trevira FR Polyester; color selected from manufacturer's standard range - Dune
   5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, same color as curtain.

B. Curtain Fabrication:
   1. Manufacture curtains of one piece, sized 10 percent wider than track length. Terminate curtain 14 inches from floor.
   2. Include open mesh cloth at top 20 inches of curtain for room air circulation.
   3. Products:
      a. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line.

B. Secure track to ceiling system to bulkhead.

C. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 2214
INTERIOR CHAIN LINK PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chain link system for walls and ceiling.

B. Access door.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - DOOR HARDWARE:

B. Section 21 3113 - Chain Link Fences and Gates; for exterior chainlink assemblies.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.

E. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2013.

F. CLFMI CLF 2445 - Product Manual; Chain Link Fence Manufacturers Institute; 1997.

1.04 DESIGN REQUIREMENTS

A. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.

B. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for screen materials, finishes, and accessories.

C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of door hardware; framed openings; anchorage, type and location of fasteners; and any items or accessories required to provide a complete system as indicated.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Framing Members: ASTM A500/A500M, Grade B cold-formed steel tubing, square and rectangular shaped.

B. Posts, Rails and Frames: ASTM f 1083 Schedule 40 hot-dipped galvanized pipe, welded construction, minimum yield strength of 25 KSI.

C. Posts, Rails and Frames: SS Designation: ASTM A1011/A1011M; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction; zinc coating conforming to ASTM F1043 Type B on pipe. Base on SS 30 High-Strength Fence Framework products by Allied Tube and Conduit.

D. Chain Link Fabric: ASTM F668 1.25 inch diamond mesh galvanized steel wire, interwoven, 9 gage, 0.1144 inch thick, top selvage twisted tight, bottom selvage knuckle end closed; including tension bars, tension wire, and accessories.

2.02 COMPONENTS

A. As indicated on drawings, or if not indicated minimum:

B. Line Posts: 2.38 inch diameter.

C. Corner and Terminal Posts: 2.88 inch.

D. Swing Gate Posts for gate leaf widths:
   1. Up to and including 6 feet: 2.88 inch.
   2. Over 6 to 12 feet: 4.5 inch.
   3. Over 12 to 18 feet: 6.63 inch.
   4. Over 18 to 24 feet: 8.63 inch.

E. Swing Gate Frame for gate leaf widths:
   1. Up to 8 feet: 1.9 inch.
   2. Over 8 feet: 2.38 inch.

F. Horizontal Slide Gate Posts for gate leaf widths:
   1. Opening Width up to 12 feet: 2.88 inch.
   2. Opening Width over 12 feet: 4.5 inch.

G. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.

H. Gate Frame: 1.66 inch diameter for welded fabrication.

I. Tension Wire: 6 gage, 0.1620 inch thick steel, single strand.

J. Tension Band: 3/4" wide x .074 inch (14 gage) thick steel.

K. Tie Wire: Aluminum alloy steel wire.

2.03 FASTENERS

A. Bolts, Nuts and Washers: Hot dip galvanized.

B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.04 ACCESSORIES

A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

C. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.

D. Floor Base: Manufacturer's standard, minimum 6 inch by 6 inch by 1/4" thick plate.

E. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

F. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

2.05 HARDWARE

A. Weld-on Latch Boxes: Coordinate with hardware schedule. Provide plates for cylinder locksets, exit devices and closers provided and installed by others. Provide boxes to accept latches, dead bolts and security access devices.

B. Protection Plates: Diamond mesh at locksets and exit devices..

C. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position unless otherwise specified in hardware sets.

D. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position unless otherwise specified in hardware sets.

E. Sliding Gate Hardware: 12 inch wide double wheel assembly, pressed steel rear wheel, heavy duty universal track bracket, gate latch to accept tenant padlock.

2.06 FABRICATION

A. Fit and assemble in largest practical sections for delivery to site, ready for installation.

B. Make exposed joints flush or tight.

C. Provide components required for anchorage to adjacent construction.

D. Frame openings made for penetrating mechanical and electrical components.

E. Fabricate gate for sliding operation.

F. Fabricate door for hinged operation .

2.07 FINISHES

A. Components and Accessories: Same finish as fabric.

B. Galvanizing: In accordance with requirements of ASTM A123/A123M.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

C. Install framework, fabric, accessories and gates in accordance with ASTM F567.

D. Place fabric on outside of posts and rails.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Provide top rail through line post tops and splice with 6 inch long rail sleeves.

G.

H. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

3.02 TOLERANCES

A. Maximum Variation From Plumb or Level: 1/4 inch.

B. Maximum Misalignment From True Position: 1/4 inch.

3.03 ADJUSTING

A. Adjust hinged and sliding doors and gates to achieve free movement.

END OF SECTION

SECTION 10 2215
INTERIOR FENCING AND GATES - RSP PERIMETER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Perimter and station guarding system complying with Tenant's specification.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - DOOR HARDWARE:

1.03 REFERENCE STANDARDS

A. Tenant's document 900-00583_R05, Perimeter Guarding and Station Guarding Speicification, as issued by Tenant's project manager.

1.04 DESIGN REQUIREMENTS

A. Design is to to provide a complete system per Tenant's specification.

B. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for screen materials, finishes, and accessories.

C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of door hardware; framed openings; anchorage, type and location of fasteners; and any items or accessories required to provide a complete system as indicated.

1.06 QUALITY ASSURANCE

A. Manufacturer and installer approved by Tenant.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. NPSG Global; www.npsgglobal.com; Contact:
   Matt Baker
   mbaker@npsgglobal.com
   (775) 771-2419

B. TROAX; www.troax.com; Contact:
   David Teulon
   david.teulon@troax.com
   +44 (0) 1793 715-193

C. Substitutions: As pre-approved by Tenant for design complying with Tenant’s specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

3.02 ADJUSTING

A. Adjust hinged and sliding doors and gates to achieve free movement.

END OF SECTION

SECTION 10 2239
FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish and install operable partitions and suspension system. Provide all labor, materials, tools, equipment, and services for operable walls in accordance with provisions of contract documents.

B. Acoustic operable panel partition.

C. Ceiling track, ceiling guards, and operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Overhead track structural support framing.

B. Section 06 1000 - Rough Carpentry: Wood blocking and track support shimming.

1.03 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

B. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

E. ASTM E413 - Classification for Rating Sound Insulation.

1.04 SUBMITTALS

A. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.

B. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.

C. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

D. Test Data: Acoustical performance shall be tested at a laboratory accredited by the U.S. Dept. of Commerce, National Institute of Standards and Technology, under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of 52 minimum. A complete, unaltered written test report shall be submitted.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.

1.06 WARRANTY

A. Partition system shall be guaranteed for a period of two years against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Design is based on Hufcor Model 642, STC 52 MINIMUM with a minimum 16-gauge steel frame, minimum 20-gauge steel face under the wallcovering, with Operable Top and Bottom Seals and vertical edge trim. Product Basis of Design: Hufcor, Inc., Janesville, Wisconsin. Tel: (800) 542-2371 Fax: (608) 758-8253. Email: info@hufcor.com, Website: www.hufcor.com.

This product is available from In/Ex Systems, Inc. Local contact: Dick Farabaugh 678-766-8201, Email: dick@inexsystems.com.

B. Substitutions: Not permitted.

2.02 COMPONENTS

A. Operable Panel Partition: Side opening; paired panels; center stacking; manually operated.
   1. Panel Finish: Upgrade vinyl consisting of Type II, reinforced vinyl weighing minimum 20 oz./lin. yard..
   2. Sound Transmission Class (STC): 52 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
   3. Surface Burning Characteristics of Panel Finish: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   4. Maximum Panel Weight: 9.5 lb/ sq. ft.
   5. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

B. Panel Construction:
   1. Panels shall be nominally 4 inch thick, up to 48 inch in width, and hinged in pairs (single panel clousres may be used as the final closure when odd numbered panels make up the wall).
   2. Panel face sheet shall be minimum 20 gage tension leveled steel with Class A rated wallcovering applied to the steel panel face with the steel face having a gypsum backing to meet the STC requirements.
   3. Frames shall be minimum of 16 gage welded frame members, formed to capture and protect vertical edges of the face material. Panels without vertical edge trim shall not be used.
   4. Lead panel shall be bulb seal, to seal against the adjacent wall without the need for wall mounted jambs.
   5. Final closure panel shall be lever panel closure, unhinged single panel.
   6. Horizontal top seals shall be retractable, provide 1” nominal operating clearance, and exert upward force when extended. All panels, including pass door panels and lever closure panels must have retractable top and bottom seals. Operable Top Seals are a strict requirement for this project. Optional sweep seals shall not be used with retractable top seals.
      a. Horizontal bottom seals shall be retractable, provide up to 2” nominal operating clearance, and exert downward force when fully extended.
         1) Horizontal bottom seals shall be operable with the use of a removable quick set handle.
         2) Operable Top and Bottom Seals must extend and retract simultaneously with the use of a quick set removable lever.
      b. Horizontal and vertical trim shall be of aluminum and finished in one of the 3 standard powder-coated finished (Lamb’s Wool, Gray, Brown).
      c. Low profile hinges on basic panels shall be of steel and finished in the same powder-coated finish as the trim and project no more than 1/4” beyond panel faces. Each pair of panels to have a minimum of three hinges.

C. Suspension system:
   1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8” dia. threaded steel hanger rods. Guide rails and/or track sweep seals shall not be required.
   2. Each panel shall be supported by one 4-wheeled carrier. Wheels to be of hardened steel ball bearings encased with molded polymer tires.

D. Finishes
   1. Face finish shall be:

a. Hufcor Standard or Designer Series Vinyl wallcovering - color and finish as indicated on drawings.
b. Exposed metal trim and seal color shall be one of the following:
1) As indicated on drawings.
(a) Aluminum track shall be clear anodized

2.03 OPERATION

A. Panels shall be manually moved from the storage area, positioned in the opening, and seals set.
1. Retractable Horizontal Seals at Top and Bottom of All Panels
a. Retractable horizontal seals shall be in every panel and be activated by a removable quick-set operating handle located approximately 42” from the floor in the panel edge.
b. All retractable seals in each hinged panel group shall be operated simultaneously.
c. Seal activation requires a 190 degree turn of the removable handle.
2. Final partition closure to be by lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45” from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4”-6” by turning the removable operating handle.
3. Stack/Store Panels
a. Retract seals with removable operating handle and move to storage area. Panels may be stored at either or both ends of the track or in a pocket.

2.04 ACOUSTICAL PERFORMANCE

A. Acoustical performance shall be tested at a laboratory accredited by the U.S. Dept. of Commerce, National Institute of Standards and Technology, under the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of 52 MINIMUM
1. Complete, unaltered written test report is to be made available upon request.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.

3.02 INSTALLATION

A. Installation. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer’s standard printed specifications, instructions, and recommendations.

B. Fit and align partition assembly and pocket doors level and plumb.

C. Install acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

A. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.

B. Cartons and other installation debris shall be removed to onsite waste collection area, provided by others.

3.05 CLOSEOUT ACTIVITIES

A. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.

B. Operating handle and owner's manuals shall be provided to owner's representative.

END OF SECTION

SECTION 10 2601
WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 SUBMITTALS

A. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Inpro; Stainless Steel Surface Mount Corner and End Wall Protectors: www.inprocorp.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Corner Guards - Surface Mounted: Extruded one-piece unit without splices, installed with adhesive.
   1. Material: Type 304 stainless steel, No. 4 finish, all edges deburred.
   2. Thickness: 16 gage, 0.06 inch.
   3. Width of Wings: 2 inches.
   4. Corner Radius: 1/8 inch.
   5. Styles: Provide 90 degree corners and wrap around end wall protectors.
   6. Attachment: Adhesive.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall.

B. Provide bead of clear sealant at top to cover exposed sharp edges.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

SECTION 10 2602
SAFETY GUARDRAIL AND SAFETY GATE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prefabricated safety guardrail.

B. Bollard Cover.

1.02 SUBMITTALS

A. Product Data: Indicate physical dimensions, features, and anchorage details.

PART 2 PRODUCTS

2.01 SAFETY GUARDRAIL

A. Manufacturer: Heartland Engineered Products - Saf-T-Rail

B. Safety Guardrail:
   1. Description: Post and rail system.
      a. C1 - 42 inch high, two rail
      b. C2 - 18 inch, one rail
   2. Rail sections shall be constructed from 11 gauge high-tensile steel formed into a two rib corrugated design with tensile ribs.
   3. Rails shall be no greater than 10 foot sections.
   4. Mounting posts shall be a minimum T.S. 4" x 4" high strength steel tubing.
   5. Base plates shall be a minimum 10 x 10 inch x 5/8 inch thick steel.

C. Finish: Standard finish shall be a heat cured, epoxy based powder coating, and shall be OSHA approved Safety Yellow.

2.02 BOLLARD COVER

A. Manufacturer: ULINE; www.uline.com
   1. Model: H-3008, Smooth, Yellow, 6 inch post, 56 inch or as required to cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on Drawings.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position.

B. Anchor safety guardrail baseplates to concrete floor with 3/4 inch diameter serrated anchor bolts. Minimum embedment of 4 inch.

C. Safety gate must be securely bolted through slab of mezzanine floor (approx.. 6 inch thick) and secured from below with plate, washers and nuts.

END OF SECTION

SECTION 10 2800
TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Accessories for toilet rooms and utility rooms.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates, and above ceiling framing.

B. Section 10 2113.13 - Metal Toilet Compartments.

1.03 REFERENCE STANDARDS

A. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

1.05 COORDINATION

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc. (ASI)
   2. Bobrick Corporation
   3. Georgia Pacific
   4. GOJO
   5. Grainger

2.02 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.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

C. Manufacturer's standard as indicated below.

2.04 COMMERCIAL TOILET ACCESSORIES

A. See Drawings for toilet accessory schedule:
   1. Toilet Paper Dispenser: vertical 4 roll, Translucent Smoke finish
      a. Georgia Pacific: 56744
   2. Grab Bar 42 inch, stainless steel, smooth:
      a. ASI: 3800-01-42
      b. Bobrick: B-6806-42
      c. Grainger: GBS15-1142-Q
   3. Grab Bar 36 inch, stainless steel, smooth:

   a. ASI: 3800-01-36
   b. Bobrick: 3800-01-36
   c. Grainger: GBS15-1136-Q
4. Tilt Mirror, 18 inch x 36 inch, #4 satin stainless steel:
   a. ASI: 0535-1836
   b. Bobrick: B-293 1836
5. Channel Frame Mirror, 18 inch x 36 inch, #4 satin stainless steel:
   a. ASI: 0620-1836
   b. Bobrick: B-165 1836
6. Paper Towel Dispenser: touchless, Translucent Smoke finish
   a. Georgia Pacific: 59462A
7. Sanitary Napkin Receptacle, #4 satin stainless stee:
   a. ASI: 852
   b. Grainger: 1ECK9
8. Toilet Seat Cover Dispenser, surface mount, #4 satin stainless steel:
   a. ASI: 20477SM
   b. Bobrick:
   c. Grainger: 1ECK2
9. Napkin/Tampon Dispenser, recessed 3 5/8 inch or greater studs, #4 satin stainless steel, Free, No-coin:
   a. ASI: 0464-FREE
   b. Bobrick: B-47064C with conversion kit 3706-250
10. Napkin/Tampon Dispenser, recessed 6 inch or greater studs, #4 satin stainless steel, Free, No-coin:
   a. ASI: 6468-FREE
   b. Bobrick: B-37063C with conversion kit 3706-250
11. Grab Bar 18 inch, stainless steel, smooth:
   a. ASI: 3800-01-18
   b. Bobrick: B-6806-18
   c. Grainger: GBS15-1118-Q
12. Soap Dispenser: Dove Gray finish
   a. GoJo: TFX 2740-12
13. Paper Towel Dispenser / Waste Receptacle, semi-recessed, #4 satin stainless steel:
   a. ASI: 20469
   b. Bobrick: B-43944
14. Shelf, surface mounted, 4 inch x 24 inch, #4 satin stainless steel:
   a. ASI: 692-424
   b. Bobrick: B-296-24 (custom 4 inch depth)
15. Robe Hook, #4 satin stainless steel:
   a. ASI: 7340-S
   b. Bobrick: B-76717
16. Clothes Hook Door Bumper, surface mount, #4 satin stainless steel:
   a. ASI: 714
   b. Bobrick: B-212
17. Door Bumper, wall surface mount, white soft dome:
   a. Everbilt: White Soft Dome Door Stop
18. Mop Holder, 24 - 26 inch, 3 spaces, #4 satin stainless steel:
   a. ASI: 8215-3
   b. Bobrick: B-223-24
   c. Fiat: 889-CC
19. Mop Hose & Bracket, 5 inch, 1 space, #4 satin stainless steel, flexible 5/8 inch hose with 3/4 inch coupling:
   a. Fiat: 832-AA

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 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 and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers.

B. UL (DIR) - Online Certifications Directory.

1.03 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. JL Industries, Inc: www.jlindustries.com.
   2. Larsen's Manufacturing Co: www.larsensmfg.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. JL Industries, Inc: www.jlindustries.com.
   2. Larsen's Manufacturing Co: www.larsensmfg.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multi-Purpose Dry Chemical Type: Steel tank, with pressure gage.
   1. Size and classification:
      a. Office Areas: 5 lb. minimum, 2A-10B:C.
      b. Warehouse Areas: 10 lb. minimum, 4A-80B:C.
   2. Finish: Baked enamel, red color.

C. MDF Room and PIT Charging: Provide 15.5 lb. Halotron 2A:10BC fire extinguisher with bracket and sign.

2.03 FIRE EXTINGUISHER CABINETS

A. Cabinet Box Metal: Formed galvanized steel sheet; 0.036 inch thick base metal.

B. Doors and Trim Metal: Formed aluminum.

C. Cabinet Configuration: Semi-recessed type.
   1. Exterior nominal dimensions of 10 inch wide by 24 inch high by 6 inch deep.
   2. Trim: Rolled edge returned to wall surface, with 2-1/2 inch projection.

D. Door Glazing: Narrow glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.

E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

F. Weld, fill, and grind components smooth.

G. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

H. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, galvanized and enamel finished. Heavy duty bracket providing top and bottom support for extinguisher.

B. Idenfification: Lettering and graphics complying with authorities having jurisdiction for letter style, size, spacing, and location.
   1. Identify bracket-mounted fire extinguishers with words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
   2. Orientation: Vertical.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

E. Install wall/column mounted fire extinguishers in Warehouse as directed by Fire Marshall.

3.03 SCHEDULES

A. Warehouse area and elevated platform area: Unless indicated otherwise, provide wall/column mounted extinguishers at a rate of 1 per 6,000 sq. ft.

B. Office Area: Unless indicated otherwise, provide fire extinguisher and cabinet at a rate of 1 per 3,000 sq.ft.

END OF SECTION

SECTION 10 7360
SITE AND STREET SHELTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured aluminum, glass and polycarbonate shelter.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-In-Place Concrete.

1.03 DESIGN REQUIREMENTS

A. Shelter materials, assembly and attachments to resist snow loads, positive and negative wind design loads at any point without damage per structural engineer's documentation.

B. Provide foundation and anchorage design per specialty structural engineer.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on shelter system, including instalation.

C. Shop Drawings: Indicate shelter, sizes, connection attachments, anchorage, size and type of fasteners, patterns and accessories.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Shelter:
   1. Products:
      a. Handi-Hut; Model #6-3WSPH Poly-Hip Shelter: www.handi-hut.com
      b. Shelters Direct; 7x14-AMZ-SH-11618-04; www.sheltersdirect.com
   2. Description:
      a. Nominal Dimension: 15 foot x 7 foot 5 inch.
      b. Finish: Dark Bronze.
      c. Glazing: 1/4 inch clear tempered glass.
      d. Roof Panels: 1/4 inch Bronze twin wall polycarbonate.
      e. Bench/Backrest: Extruded aluminum.
      f. Hardware/Anchorage: Tamperproof.
      g. Openings: Left and right front.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FABRICATION

A. Fabricate components with joints tightly fitted and secured.

B. Supply components required for anchorage of framing. Fabricate anchors and related components of same material and finish as framing, except where specifically noted otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

END OF SECTION

SECTION 10 7500
FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

A. Section 03 3000: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

D. NAAMM FP 1001-07 - Guide Specifications for Design of Metal Flagpoles.

E. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to NAAMM FP 1001-07, "Guide Specifications for Design of Metal Flagpoles".

B. Base flagpole design on maximum standard size nylon flag suitable for use with pole.
   1. Anticipate up to 3 flags per pole, American at 6’x10’ maximum and other 2 at 3’x5’ maximum, total area not exceeding maximum standard size of pole design.

1.05 SUBMITTALS

A. See Section 01 3000 - 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.

1.06 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
   1. American Flagpole: www.americanflagpole.com.
   2. Concord Industries, Inc: www.concordindustries.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001.
   1. Material: Aluminum.
   2. Design: Cone tapered.
   3. Mounting: Ground mounted type.
   4. Nominal Height: One pole at 30 ft; measured from nominal ground elevation.
   5. Halyard: Interior rotating type .

2.03 POLE MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum gold anodized, 6 inch diameter or size to match pole butt diameter..

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Cleats: 9 inch size, aluminum with galvanized steel fastenings, two per halyard.

D. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.

E. Halyard Flag Snaps: Provide 2 swivel snap hooks per flag, chrome plated bronze.

F. Halyard: #10 (5/16 inch diameter) Braided Polypropylene or Nylon.

G. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.

H. Collar: Manufacturer’s standard spun aluminum flash collar to match flagpole.

2.05 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36M, corrugated minimum 16 gage steel, galvanized, sized to suit flagpole and installation. Provide with 3/16 inch steel bottom plate and steel centering wedges all welded together. Furnish with 3/16 inch support plate, 3/4 inch diameter x 18 inch long steel ground (lightning) spike, all welded construction. .

B. Pole Base Attachment: Flush; steel base with base cover.

2.06 FINISHING

A. Aluminum: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Excavation: For foundations, excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.

B. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure forms, foundation tube, or anchor bolts in position, braced to prevent displacement during concreting.

C. Place concrete immediately after mixing. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than 7 days or use a non-staining curing compound.

D. 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 base perimeter

3.03 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.

B. Foundation-Tube Installation: Install flagpole in foundation tube, seated on bottom plate between steel centering wedges. Plumb flagpole 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 sealant and cover with flashing collar.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 11 1300
LOADING DOCK EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydraulic Dock Leveler.

B. Truck Restraint Device and Communication System.

C. Dock Seal.

D. Dock Bumper.

E. Track Guard.

F. Combination Dock Light and Fan.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Placement of leveler frame into concrete loading dock.

B. Section 03 3000 - Cast-in-Place Concrete: Concrete pit.

C. Section 05 5000 - Miscellaneous Metals: Dock edge angles

D. Division 26 - Electrical: Power wiring and control wiring conduits for dock equipment.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit .

C. Shop Drawings: Indicate required opening dimensions, tolerances of opening dimensions, perimeter conditions of construction.

D. Operation Data: Provide operating instructions, identify unit limitations.

E. Maintenance Data: Provide unit maintenance information, lubrication cycles, spare parts manual.

1.04 WARRANTY

A. Proposals submitted without the following written warranties will be considered non-responsive.
   1. This warranty is based on a standard fork lift truck operating procedure. A standard procedure is; no load shall exceed the rated lift capacity of the truck, and no load shall be pre-staged or stacked and pushed or pulled over the dock leveler into or out of the truck.
   2. Dock leveler manufacturer shall provide with his bid a written 10 year money back Structural Warranty on dock levelers. Warranty shall be based on the following criteria:
      a. Gross weight of fork lift and load shall not exceed 14,000 lbs.
      b. User's operations shall not exceed 6 full truck loads per 24 hour period over any one dock position.
      c. Lift truck speed shall be no more than 5 mph. Leveler grade shall be no more than the recommended grade as determined by the material handling equipment manufacturer and never more than 7.17%.

B. All parts not covered under the 10 Year Structural Warranty will have a 2 year parts, 2 year labor warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. 4Front Engineered Solutions / Kelley Company: www.4Frontes.com.
      Contact:
      Chuck Zimmermann

Manager, National Accounts
4Front Engineered Products
N56 W24701 Corporate Circle
Sussex, WI 53150
M: 414-745-8477
chuck.zimmermann@4Frontes.com

2. Rite-Hite Corp: www.ritehite.com.
   Contact:
   Josh Morgan
   Arbon Equipment Corporation
   22718 58th Place South
   Kent, Wa 98032
   O: 253-395-7099
   M: 253-951-5694
   jmorgan@ritehite.com

3. Poweramp / McGuire: www.loadingdocksystems.com.
   Contact:
   Jeff Schulze
   Systems, Inc.
   W194 N11481 McCormick Drive
   Germantown, WI 53022
   O: 800-643-5424
   M: 920-716-1510
   jeffschulze@loadingdocksystems.com

4. Blue Giant Equipment Corp.: www.bluegiant.com
   Contact:
   David Rimmer
   Blue Giant Equipment
   410 Admiral Boulevard
   Mississauga, Ontario L5T 2N6
   O: 800-872-2583
   M: 647-501-3126
   drimmer@bluegiant.com

5. Substitutions: Not permitted.

2.02 DOCK LEVELER

A. Acceptable Manufacturers:
   1. 4Front / Kelley Company: HK Series - HK 7840:16_LS
   2. Rite-Hite Corp.: HL Series - HL987-40K
   3. Poweramp / McGuire: LHP Series - LHP-78
   4. Blue Giant: H Series - H7008H
   5. Substitutions: Not permitted.

B. Description:
   1. Operation: Hydraulic.
      a. Provide electric hydraulic raising and hydraulic lowering of the ramp, controlled from a remotely located push-button station. Provide a hydraulic velocity fuse to limit the loaded ramp's free fall to not over 3 inches.
   2. Deck Size: Nominal 7 feet x 8 feet.

3. Operating Range: 12 inches above dock level, 12 inches below dock level. Provide an operating range above the platform level of sufficient height to enable the lip to extend and clear the truck bed before contact
4. Capacity: 40,000 lbs. in accordance with ANSI MH30.1-2015
5. Automatic Vertical Compensation: Floating travel of the ramp with lip extended and resting on the truck bed shall compensate automatically for upward or downward movement of the truck bed during loading and unloading.
6. Automatic Lateral Compensation: Tilting of the ramp with lip extended and resting on the truck bed shall compensate automatically for canted truck beds of up to 4 inches over the width of the ramp
7. Lip Operation: Provide the manufacturer's standard mechanism that automatically extends and supports the hinged lip on the ramp edge with the lip resting on the truck bed over the dock leveler's working range, allows the lip to yield under impact of the incoming truck, and automatically retracts the lip when the truck departs.
   a. Lip length shall be 16 inches typical.
8. Leveler Stored Switch: Factory installed and wired to Master Control Panel.
9. Finish: Manufacturer's standard paint applied to factory assembled leveler before shipping.
10. Dock Leveler Control Box: All individual components, as well as the complete box unit, shall be UL-approved 460v/3P single enclosure. This enclosure shall operate both the dock leveler and dock restraint and contain a step down transformer for the trailer restraint. This shall allow for one incoming power source.
    a. Include hard wired connection to fan and dock light, and include individual switch capability.
11. Accessories:
    a. Night locks.
    b. Safety stops.
    c. Toe guards integral for full operating range, painted safety yellow.
    d. Side and rear weatherseals.
    e. Safety Strut: Integral, permanently attached to unit.

2.03 TRAILER RESTRAINING DEVICE AND COMMUNICATIONS SYSTEM:

A. Manufacturer: Provide equipment from the same manufacturer as the dock leveler.
   1. 4 Front / Kelley: - Model APS2000
   2. Rite-Hite Corp.: GRH-700 with Dok-Commander
   3. Poweramp / McGuire: TPR Vehicle Restraint with iDock Combo Panel
   4. Blue Giant: Strongarm HVR303 with Blue Genius Platinum-AMZ Touch Control Panel
   5. Substitutions: Not permitted.

B. Truck Restraint Description:
   1. Type: Upward biased restraining hook, capable of restraining 30,000 lbs of force without sustaining structural damage to the restraint. Provide steel mounting plate with anchor bolts for securing to concrete foundation wall.
   2. Restraining Range: Restraint will engage underside of ICC bar between 9 inches and 30 inches above ground, measured on a level surface.
   3. Operation: Powered operation, push-button controls for engagement and return to storage.
   4. Controls: NEMA 12 control panel, complete with red and green LED lights, and instruction label.
   5. Release of restraining hook shall be actuated only from inside.
   6. Provide interlock between dock door and leveler, and leveler and truck restraint. Leveler cannot raise without door in full open position, and without truck restraint in engaged position.

C. Safety Communications System:

1. Inside instruction aluminum or metal placard and flashing red and green LED lights mounted in low profile box. Outside caution sign with instructions for truck driver, and flashing red and green LED lights.
2. Interlock system to signal contact of the hook with the ICC bar, red exterior/green interior with hook engaged and green exterior/red interior with hook in stored position.
3. Dock Equipment Sequence of Operations:
   a. Engage Trailer Restraint OR place in Override Mode-Outside light changed to red.
   b. Open Manual Door-Limit Switch provided by dock manufacturer, installed and wired by others. Once the door is fully open the inside light changes to green. Only when the dock door is fully opened and inside green LED light is on will the dock leveler be enabled.
   c. Raise Dock Leveler.
   d. Dock Light On from Auto Switch Position when dock leveler leaves the stored position.
   e. Store Dock Leveler-Inside Light Changes to Red.
   f. Dock Light Off from Auto Position when the dock leveler is stored.
   g. Vehicle restraint can only be released when the dock leveler is stored.
   h. Release Restraint-Outside Light Changes to Green.

2.04 DOCK CONTROL SYSTEM

A. 4Front / Kelley – Model APS2000
   1. Provide integrated dock equipment control box with door interlock to dock restraint so that leveler will not operate without restraint engaged. Provide and interlock with leveler and door limit switch so that leveler will not operate without door in an open position.
   2. RiteHite – GRH-700 Dok-Lok with Dok-Commander
   3. Poweramp / McGuire – TPR Vehicle Restraint with iDock Combo Panel.

B. Dock Communication Lights: Red and Green LED light signals on interior and exterior with signage. Provide zee-shape brackets to mount exterior light and signage as required to avoid interference with downspouts.

C. Dock communications package to provide a service and maintenance lock-out.

D. Dock communication package to include an interlock so that the leveler cannot be used without the dock door being in a fully open position.

E. Dock communication package to include and interlock so that leveler cannot be used without the trailer restraint being properly engaged.

F. Dock communication package to include hard wired connection to fan and dock light, and include individual switch capability.

2.05 DOCK SEALS:

A. Acceptable Manufacturers:
   1. 4 Front / Kelley Company: Model SWH100-10-WP4 with AQS900 Aquashield Rain Seal
   2. Rite-Hite Corp.: Classic Dock Seal with Traditional Head Curtain and RainGuard RG-3000 Header Seal
   3. Poweramp / McGuire: Fairborn USA, Inc.: Series 1400/TS103 with RainDiverter Series 1550
   4. Blue Giant: BG200V-40 with RainShroud
   5. Substitutions: Not permitted.

B. Description:
   1. Type: foam-fit pad type with adjustable head curtain above side pads.
   2. Head: 24 inch high, adjustable with 12 inch splits with velcro and pull rope assembly. Provide armor pleating at each end of the head curtain.
   3. Side Pad: Beveled side pads, 6 inch width at rear and 12 inch width at front. Provide 4 inch wide guide stripes.
   4. Projection of Head and Side Pads: 10 inch.

5. Fabric: Base fabric- 22 oz vinyl. Head fabric- 40 oz vinyl. Wear Pleats- provide with full height side pad wear pleats of 40 oz. vinyl, 4 inch pleat overlap.
6. Blocking/nailers to be pressure treated wood.

2.06 DOCK BUMPERS

A. Acceptable Manufacturers:
1. 4 Front / Kelly Company: Trak-Model VBR420-11F
2. Rite-Hite Corp.: Model V420-11
3. Poweramp / McGuire: Model B4520-11P1
4. Blue Giant: BGV420-11-C
5. Substitutions: Not permitted.

B. Description: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position with two steel rods with threaded ends, washers and nuts; between 3 x 2-1/2 x 1/4 inch steel angle end plates:
1. Projection From Wall: 4-1/2 inches.
2. Size: 20 inch high x 11 long.
3. Location: All dock doors and trailer spaces against building wall.

2.07 TRACK GUARDS

A. Acceptable Manufacturers:
1. 4 Front / Kelly Company: Trak-Sentry-HD
2. Rite-Hite Corp.: Warden Track Guard
3. Poweramp / McGuire: Track Guards
4. Blue Giant: Model 70-0005-48-6
5. Substitutions: Not permitted.

B. Description: “Z” shape door track protector made from ¼ inch thick steel shapes with wall and floor mounting flange.
1. Height: 4 feet.
2. Color: Prefinished safety yellow enamel coating.

2.08 DOCK LIGHT AND FAN

A. Acceptable Manufacturers:
1. 4 Front / Kelly Company: HV-ES Fan
2. Rite-Hite Corp.: CoolMan 2800
3. Poweramp / McGuire: LED Light/Fan Combo
4. Blue Giant: FANDL40-PLED
5. Substitutions: Not permitted.

B. Description: Combination dock light and fan on 42 inch heavy duty swing arm. High Impact LED Fixture.
1. Factory assembled, hardwired, adjustable dock light with fan.
   a. Dock light/fan assembly to the following requirements:
      1) Dock light/ fan assembly to be UL/ ETL/cETL listed.
      2) Provide with exterior rated junction box/hardwired configuration.
      3) Dock light and fan controlled separately.
      4) Operating Voltage: 120VAC/60Hz single phase operation.
      5) Dock fan: Provide with protective grill for operator safety. Configured to provide consistent airflow into docked trailer. Minimum 2000 CFM in continuous operation.
      6) LED Dock light: Minimum 15W lamp, 25° beam angle, 50,000 hour expected lamp life, provide with stainless steel hardware. Provide with impact resistant, clear polycarbonate lens, conform to FDA/USDA requirements for food facilities.
      7) Dock light to have compact head design weighing less than 4 lb. Allow for 180° rotation of light head. Light/ fan assembly/ housing provided with safety yellow finish

8) Dock light/ fan assembly provided with load assist mechanism rated for 25,000 cycle average life
9) Dock light/ fan assembly provided with 3-year limited warranty

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough-in openings are acceptable.

3.02 INSTALLATION:

A. Install dock equipment in accordnce with manufactuer's instructions.

B. Dock Leveler:
   1. Install dock leveler unit in prepared opening in accordance with manufacturer's instructions.
   2. Set square and level.
   3. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.

C. Secure truck restraint device to foundation wall with anchor bolts and weld top to dock pit angle.

3.03 DOCK SEALS:

A. Preparation:
   1. Verify wall openings are sized and aligned to tolerances.
   2. Verify required anchors will fit and are compatible with size and openings.

B. Erection:
   1. Erect door seals in accordance with manufacturer's instructions and shop drawings.
   2. Attach anchors and fittings to prepared wall construction and opening frame.
   3. Use galvanized fasteners permitting site adjustment and alignment.

3.04 ADJUSTING

A. Adjust installed unit for smooth and balanced operation.

END OF SECTION

SECTION 12 2113
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Horizontal slat louver blinds at all exterior glazed areas unless indicated otherwise.

B. Operating hardware.

1.02 RELATED REQUIREMENTS

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating physical and dimensional characteristics.

C. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, cord type and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Horizontal Louver Blinds Without Side Guides:
   1. Levolor Contract; Product Riviera Classic: www.contract.levolor.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BLINDS WITHOUT SIDE GUIDES

A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.

B. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by cord; complying with WCMA A100.1.

C. Metal Slats: Spring tempered pre-finished aluminum; radiused slat corners, with manufacturing burrs removed.
   1. Width: 1 inch.
   2. Thickness: 0.008 inch.
   3. Color: As selected by Architect.

D. Slat Support: Woven polypropylene cord, ladder configuration.

E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.

F. Bottom Rail: Pre-finished, formed aluminum with top side shaped to match slat curvature; with end caps. Color: Same as headrail.

G. Control Wand: Extruded hollow plastic; hexagonal shape.

H. Headrail Attachment: Wall brackets.

2.03 FABRICATION

A. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

3.02 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

3.03 ADJUSTING

A. Adjust blinds for smooth operation.

3.04 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Window shades and accessories.

1.02 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

C. WCMA A100.1 - Safety of Window Covering Products.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Do not install shades until final surface finishes and painting are complete.

1.04 SUBMITTALS

A. See Section 01 3000 - 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.

C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 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.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manually Operated Roller Shades:
   1. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
   2. Basis of Design: Blinds.com; Commercial Roller Solar Shade: www.blinds.com/p/blindscom-commercial-roller-solar-shade/533522
      a. Contact:
         Danielle Sansone
         danielles@blinds.com
         (713) 430-4945
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROLLER SHADES

A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
   1. Size: As indicated on drawings.
   2. Roll Direction: Standard
   3. Bracket only for inside mount, fascia valence for outside mount.

B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.

1. Opacity: 3%, unless drawings identify differently.
2. Ends: Sealed.
3. Flammability: Pass NFPA 701 large and small tests.
4. Color: As indicated on drawings.

C. Roller Tubes: As required for type of operation.

D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.

E. Manual Operation for Interior Shades: Clutch operated continuous loop; Color coordinated plastic.

2.03 ACCESSORIES

A. Fascias: Size as required to conceal shade mounting.
1. Style: As indicated on drawings.
2. Material and Color: To match shade.

B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.

C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.04 FABRICATION

A. Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with maximium 1/4 inch space between bottom bar and window stool.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Installation Tolerances:
1. Maximum Offset From Level: 1/16 inch.

C. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.02 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.03 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION

SECTION 12 4813
ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet mat.

1.02 SUBMITTALS

A. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.

B. Shop Drawings: Indicate dimensions and details for recessed frame.

C. Samples: Submit two samples, 4 by 4 inch in size illustrating pattern, color, finish, edging.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Floor Mats:
   1. Matworks Inc. (800-523-5179); Diamond Mat II: www.thematworks.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ENTRANCE FLOOR GRILLES AND GRATINGS

A. Mounting: Top of non-resilient members level with adjacent floor.

B. Structural Capacity: Capable of supporting a rolling load of 500 pounds without permanent deformation or noticeable deflection.

C. Vibration Resistant Fabrication: All members welded, riveted, or bolted; no snap or friction connections.

2.03 MATS

A. Rubber Mat
   1. Thickness: 7/16 inch (10.5 mm) thick mat
   2. Surface Design: Diamond
   3. Size: 19.5 x 19.5 inch Tiles
   4. Color: #DM01 (Charcoal).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

END OF SECTION

SECTION 12 9313
BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bicycle racks.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.03 SUBMITTALS

A. See Section 01 3000 - 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. Installation methods.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Outdoor Bicycle Racks:
   1. Equal to Madrax Model # HW238-17-IG, heavy-duty winder rack.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Bicycle Racks: Tubular steel pipe formed to allow at least one bicycle to lock simultaneously on each bend and each end, securing one wheel and part of the frame.
   1. Pipe: Carbon steel, ASTM A 53/A 53M; NPS 2, Schedule 40 (2-3/8 inch O.D., 0.154 inch wall).
   2. Capacity:17 bicycles.
   3. Mounting: In-ground anchor.
   4. Finish: Powder coat, maintenance-free and weather-resistant.
   5. Color: Black.
   6. Accessories: In-ground grout cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bicycle racks level, plumb, square, and correctly located as indicated on drawings.

C. In-Ground Anchor Installation:
   1. Prepare holes in size according to manufacturer’s instructions.
   2. Place anchoring bolts through the holes in the pipe.

3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
4. Pour concrete and level rack.
5. Support until dry.

END OF SECTION

SECTION 13 3420
PRE-ENGINEERED CANOPY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel canopy system.

B. Metal wall and roof panels including soffits and gutters and downspouts.

1.02 REFERENCE STANDARDS

A. AISC 360 - Specification for Structural Steel Buildings.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

C. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

E. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

F. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.

G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

H. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.

1.03 DESIGN REQUIREMENTS

A. Design foundations and 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. Size and fabricate fascia and roof systems free of distortion or defects detrimental to appearance or performance.

1.04 SUBMITTALS

A. See Section 01 3000 - 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, foundations design and details, connections; wall and roof system dimensions, panel layout, general construction details, and method of anchorage, installation ; framing anchor bolt settings, sizes, and locations from datum, foundation loads and anchorage; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.

D. Design calculations sealed and signed by registered engineer in the state in which the job is located.

E. Electrical requirements to coordinate power with electrical engineer.

1.05 QUALITY ASSURANCE

A. 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 Work.

1. Design Engineer Qualifications: Licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Buildings:

1. Shelters Direct; www.sheltersdirect.com
   Contact: Rob Van Schaik
   Direct 301-323-1319
   rob@sheltersdirect.com
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STRUCTURAL COMPONENTS

A. Columns:
   1. Structural steel tubing shall be used.
   2. Square steel tube to be ASTM A500 Grade C, minimum yield strength 50 ksi
   3. Round steel tube to be ASTM A500 Grade B, minimum yield strength 42 ksi
   4. Size to meet or exceed specific project design load requirements.
   5. Provide each column with a 4” electrical access opening and cover plate.

B. Base Plates:
   1. ASTM A572, Grade 50 plate to be a minimum ¾” thickness with welded gussets. Shop fabricated with pre-punched or pre-drilled bolt holes.

C. Top Plates:
   1. ASTM A572, Grade 50 plate to be a minimum ¾” thickness with welded gussets. Shop fabricated with pre-punched or pre-drilled bolt holes.

D. Structural Framing:
   1. ASTM A992, 50 ksi wide-flange steel beams shall be used.

E. Structural Connections:
   1. ASTM A36 structural steel for miscellaneous plates and angles.
   2. All framing members shall be shop fabricated for bolted field assembly.
   3. Domestic ASTM A325 high strength bolts shall be used. All ASTM A325 bolts shall be installed per the RSCS Specification for Structural Joints, contained in part 16, Specifications and Codes of the AISC Steel Construction Manual, latest edition.
   4. Flange and purlin bracing where required.

F. Anchor Bolts:
   1. ASTM F1554 Grade 55 hex head bolt with a minimum yield strength of 55 ksi.
   2. 1 ¼” diameter x 30” long standard bolt with the hex head embedded in concrete footer.
   3. Threaded projection above footing shall be 7”.
   4. Double nuts and washers for each bolt shall be provided, one set to be used for plumbing and leveling.
   5. Templates for setting anchor bolts shall be provided.
   6. Templates shall be removed before setting column on foundation.

G. Painting:
   1. All framing members will be given one shop coat of drying red oxide primer.

2.03 FOUNDATIONS

A. Site specific design by a licensed engineer based on applicable code and project location, independent of and separated from building structure.

2.04 DECK PANELS

A. ASTM A792 Galvalume having an AZ50 aluminum-zinc coated surface, minimum yield strength of 50 ksi.

B. 20 gauge, 16” wide x 3” deep steel panels.

C. Panels are fastened to the wide-flange beams with an engineered screw type clamp and lock nut system.

D. No splicing of deck panels will be allowed.

E. Panels shall have a finish side coated with a full coat of polyester paint baked on over an epoxy primer. A white wash coat of polyester baked on over an epoxy primer shall protect the reverse side.

F. Panels to be manufactured in sufficient length to avoid unnecessary center gutters.

2.05 FASCIA

A. ACM Panels: Aluminum composite material, of varying thicknesses, is a sandwich panel consisting of 2 aluminum sheets bonded to a polyethylene core.
   1. Paint Color: Bone White.

B. Fascia Attachment Systems: Fascia support braces to be 20 gauge galvanized steel. Braces are formed into a C-channel 1 ½” wide x 1 1/4” deep x 10’ long.

2.06 ACCESSORIES

A. Gutter:
   1. Straight sections to be ASTM A792 Galvalume having an AZ50 aluminum-zinc coated surface.
   2. Straight sections of 20 gauge steel are 8” wide x 6” deep.
   3. Straight gutter sections shall have a finish side coated with a full coat of polyester paint baked on over epoxy primer. A white wash coat of polyester paint baked on over epoxy primer shall protect the interior surface.

B. Downspouts:
   1. External downspouts to be 4” x 3” roll formed 26 gauge steel with watertight locked seams.
   2. Exterior paint with one full coat of polyester paint baked on over epoxy primer.
   3. Downspouts to be of one contiguous length up to 15’.
   4. Connect to subsurface drain or to grade as indicated on drawings.

C. Collectors: Circular and constructed of gel-coated fiberglass

D. Internal Drains: 3” schedule 40 PVC.

E. Hardware: Gutter to deck panel fasteners shall be ¼” dia. x ¾” long self-drilling screws.

F. Sealant: Tube sealant shall be 100% urethane caulk for water-proof areas, and silicone caulk for cosmetic.

2.07 ELECTRICAL/LIGHTING

A. Conduits and boxes for circuits as required for lighting and outlets.

B. LED Lighting, surface mount, based on Whiteway/Hubbell CLED-HL-UNV-S-5-WH-LED.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

3.02 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

SECTION 14 2100
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Complete electric traction elevator systems.
   1. Service type.

B. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Includes elevator machine foundation and elevator pit.

B. Section 05 1200 - Structural Steel Framing: Includes hoistway framing and overhead hoist beams.

C. Section 05 5000 - Metal Fabrications: Includes elevator pit ladder and sill supports.

D. Section 09 2116 - Gypsum Board Assemblies: Gypsum shaft walls.

E. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler heads in hoistway.

F. Division 23 - HVAC: Ventilation and temperature control.

G. Division 26 - Electrical: Equipment Wiring.

H. Section 26 0533.13 - Conduit for Electrical Systems:

I. Section 26 2717 - Equipment Wiring:

J. 28 3000 - Two-Way Emergency Communication System:

K. Section 28 3100 - Fire Detection and Alarm:
   1. Fire and smoke detectors and interconnecting devices.

1.03 REFERENCE STANDARDS

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

B. AISC 360 - Specification for Structural Steel Buildings.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

D. ASME A17.1 - Safety Code for Elevators and Escalators.

E. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks.

F. AWS D1.1/D1.1M - Structural Welding Code - Steel.

G. ITS (DIR) - Directory of Listed Products.

H. NFPA 13 - Standard for the Installation of Sprinkler Systems.

I. NFPA 70 - National Electrical Code.

J. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.

K. UL (DIR) - Online Certifications Directory.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to, the following:
      a. Elevator equipment devices remote from elevator machine room or hoistway.
      b. Remote group automatic panel from controller cabinet.
      c. Telephone service for elevator equipment.
      d. Elevator pit for lighting and sump pump.
      e. Automatic transfer switch from controller cabinet.
      f. Fire alarm panel from controller cabinet.

2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:
   a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
   b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation; include provisions for shunt trip power monitoring.

B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, field quality control, adjusting, cleaning, protection,and coordination with related work.

C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.

C. Shop Drawings: Submit drawings and details on following items:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
   3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
   4. Clearances and over-travel of car and counterweight.
   5. Locations in hoistway of traveling cables and connections for car lighting and telephone.
   6. Location and sizes of hoistway and car doors and frames.
   7. Electrical characteristics and connection requirements.
   8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

D. Color selection: Submit color charts of exposed finishes and materials for color selection.
   1. When requested, submit samples of exposed finishes and materials selected for the elevator system materials and components.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

F. Operation and Maintenance Data:
   1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
   2. Operation and maintenance manual.
   3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer Qualifications: To be installed by manufacturer.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

D. Products Requiring Fire Resistance Rating: Listed and classified by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.

E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer/installer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer/installer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer/installer's instructions.

C. Handling: Protect materials during handling and installation to prevent damage.

1.09 PROJECT CONDITIONS

A. Temporary Electrical Power:
   1. Owner will arrange for temporary 220 VAC, single-phase, 60 Hz., GFCI-protected electricity to be available for installation of elevator components.
   2. Comply with Section 015100 - Temporary Utilities.

B. Installation of the Elevator:
   1. General Contractor will provide permanent three-phase power prior to installation start.
   2. General Contractor will provide clear, rollable access to a 20' x 10' secure and dry storage area prior to delivery.
   3. General Contractor will provide a clean, dry, and complete hoistway along with temporary installation platform and all required OSHA-compliant barricades prior to delivery.

1.10 MAINTENANCE SERVICE

A. Elevator maintenance service shall be performed by elevator manufacturer/installer.

B. Elevators shall receive regular maintenance on each unit for period of 12 months after completion of work specified herein or acceptance thereof by beneficial use, whichever is earlier.

C. Trained employees shall make periodic examinations and perform work including necessary adjusting, greasing, oiling, and replacing parts to keep elevators in operation, except parts that require replacement because of accidents, vandalism, misuse, or negligence by parties other than manufacturer/installer.

D. Manufacturer/installer shall perform all Work, except emergency minor adjustment call-back service, during regular working hours. Manufacturer/installer shall provide emergency minor adjustment call-back service, during regular working hours.

E. Should Owner request that examinations, cleaning, lubrication, adjustments, repairs, replacements, or emergency minor adjustment call-back service, unless specified herein, be performed on other than manufacturer/installer's regular working hours of regular working days, manufacturer/installer shall absorb straight-time labor charges and Owner will compensate manufacturer/installer for overtime premium, travel time, and expense at normal billing rates.

F. Elevator Control System:
   1. Include built-in remote diagnostic module to relay constant status of elevators and control system to a 24-hour, 7-days-a-week central-monitoring facility.
   2. Remote Monitoring Device: Transmit information on current status of elevators, including malfunctions, system errors, and shutdown.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Electric Traction Elevators: Schindler.

B. Other Acceptable Manufacturers - Electric Traction Elevators:
   1. Schindler Elevator Corporation; 3300 XL Gearless Traction Elevator: www.us.schindler.com/#sle.
   2. ThyssenKrupp Elevator: www.thyssenkruppelevator.com.

C. Substitutions: See Section 01 6000 - Product Requirements.
   1. For any product not identified as Basis of Design, submit information as specified for substitutions.

D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

E. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.02 ELECTRIC TRACTION ELEVATORS

A. Electric Traction Service Elevator, No. 1:
   1. Application: Machine Room Less (MRL)
   2. Counterweight Location: Side
   3. Machine Location: Top of the hoistway mounted on car and counterweight guide rails
   4. Control Space Location: Top landing entrance frame or entrance frame at one floor below the top landing
   5. Service: Hospital/service
   6. Quantity: 1 Unit
   7. Interior Car Height: 96 inch nominal
   8. Rated Net Capacity: 4500 pounds.
   9. Rated Speed: 150 feet per minute.
   10. Hoistway Size: As indicated on drawings.
   11. Interior Car Platform Size: As indicated on drawings, sized to accept gurney straight in.
   12. Elevator Pit Depth: 60 inch.
   13. Overhead Clearance at Top Floor: 154 inch.
   14. Travel Distance: As indicated on drawings.
   15. Number of Stops: As indicated on drawings.
   16. Number of Openings: As indicated on drawings
   17. Hoistway Entrance Size: 4 foot wide x 7 foot high
   18. Door Type: Two Speed Side Opening
   19. Operation: Microprocessor Single Car Automatic Operation
   20. Guide Rails: Equivalent to 12 lb. per foot
   21. Power Supply: 480 Volts 3 Phase

B. Electric Traction Service Elevator, No. 2:
   1. Application: Machine Room Less (MRL)
   2. Counterweight Location: Side
   3. Machine Location: Top of the hoistway mounted on car and counterweight guide rails
   4. Control Space Location: Top landing entrance frame or entrance frame at one floor below the top landing
   5. Service: Hospital/service
   6. Quantity: 1 Unit
   7. Interior Car Height: 96 inch nominal
   8. Rated Net Capacity: 4500 pounds.

SECTION 144551
VERTICAL RECIPROCATING CONVEYOR

A. The specification detailed herein is intended for the design, manufacturing, and installation of a Mezzanine Style, Manually Loaded Vertical Reciprocating Conveyor (VRC) for enclosed shaft and open for mezzanine platform, including lift carriage, outer enclosures, safety gates, mechanical drive unit, and operator controls.

B. Specific styles of VRC's, as indicated on drawings, include the following:

1. C–Pattern Large Unit
2. Z-Pattern Slam Unit

1.02 RELATED SECTIONS

A. Division 26 - Electrical: Equipment Wiring

B. Division 28 - Electronic Safety and Security

1.03 REFERENCES

A. The following standards must be adhered to by the VRC supplier and are in the project scope:

1. ASME A17.1/CSA B44 Handbook
2. ASME B20.1 - Safety Standard for Conveyors and Related Equipment; American Societyof Mechanical Engineers.
3. AWS – American Welding Society (AWS D1.1)
4. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
5. VQ Checklist v1.0 - https://docs.b360.autodesk.com/shares/6d8ad750-7c49-498e-b7bd-7e43c0452839
6. Spare Parts Template v1.0 - https://docs.b360.autodesk.com/shares/c455d7ac-afc7-4825-9d9a-2411f9ad4db1
7. Reference 'G. WWDE Global Controls Engineering Specification v2.15 – https://docs.b360.autodesk.com/shares/b730036b-e0c0-4ff5-98d3-d7fdb27e3788

1.04 CONTRACTING REQUIREMENTS

A. Tenant Procurement team will assign an Installer and Manufacturer to each project and inform the Tenant Pre-Construction and Construction Manager. The General Contractor will then contract with the specified Installer or Manufacturer.

1. Approved Installer(s):

   Contact(s):

   Otis Elevator Company Greg Anderman greg.anderman@otis.com

   (541) 647-2602 Office (714) 493-4929 Mobile

Gebhardt USA, Inc.
Jim Kappele j.kappele@gebhardtusa.com
(216) 650-1000 Office

Cisco Eagle Tim Harris
tim.harris@cisco-eagle.com (972) 331-3053 Office
(469) 765-6108

Tenant Procurement team may assign installers not on the list below to pilot locations.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to, the following:
   a. Pit recess.
   b. Lift equipment devices and controls.
   c. Fire alarm panel from controller cabinet.

B. Pre-installation Meeting: Convene meeting at least two weeks prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, field qualitycontrol, testing, adjusting, cleaning, protection, and coordination with related work.

C. Construction Use of Lift: Not permitted.

1.06 SUBMITTALS

A. See Section 01 7000 - for submittal procedures.

B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.
   5. Any special conditions or requirements.
   6. Detailed mechanical assemblies with BOM.

C. Shop Drawings: Submit drawings and details on following items:
   1. Lift Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
   3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.

4. Clearances and over-travel of car.
5. Location and sizes of hoistway and car doors and frames.
6. Electrical characteristics and connection requirements.
7. Indicate arrangement of lift equipment and allow for clear passage of equipment through access openings.

D. Maintenance Data:

1. Parts catalog with complete list of equipment replacement parts.
2. Technical information for servicing operating equipment.
3. Legible electrical schematic drawing including control panel layout and diagrams of installed electrical equipment.
4. See Section 017823 Operational and Maintenance Data for additional requirements.

E. Closeout documentation for an installation must be provided prior to the First Receive date.

1. 3 printed copies and PDF copy of Electrical Schematics Drawing; including thecontrol panel layout and wiring diagrams.
2. 3 printed copies and PDF copy of Mechanical Installation Manual and Electrical Installation Guide.
3. 3 printed copies and PDF copy of Control Panel troubleshooting guide.
4. 3 printed copies and PDF copy of the Owner's Manual incorporating a spare parts list, operating instructions, maintenance schedules, As-built drawings and service and troubleshooting guidelines.
   A. Maintenance schedules shall include visual aids to assist in verifying a 'good' component versus a 'failing' component.
5. 1 copy of Programmable Logic Controller (PLC) program.
6. See Section 01 7800 Closeout Procedures for additional information.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of experience.

1. Manufacturer must guarantee compliance with ASME B20.1 Safety Standard for Conveyors and Related Equipment.

1.08 WARRANTY

A. See Section 017800 - Closeout Procedures, for additional warranty requirements.

B. The manufacturer shall warrant the VRC against defects from date of acceptance, as outlined below:

1. Electric Motor and Reducer
   a. Parts: 2 year
   b. Labor: 2 year
2. Electrical Components
   a. Parts: 3 year
   b. Labor: 1 year

3.Mechanical Components

a.Parts: 1 year

b.Labor: 1 year

4. Structural Frame, Supports and Carriage Frame
   a. Parts: Lifetime
   b. Labor: Lifetime
5. Roll-Up-Door motor/gearbox
   a. Parts: 5 year
   b. Labor: NA
6. Roll-Up-Door Electrical Components
   a. Parts: 2 year
   b. Labor: NA
7. Roll-Up-Door Operation and Drive System
   a. Parts: 500K Cycles
   b. Labor: NA
8. Roll-Up-Door Track Funnels
   a. Parts: 100K Cycles
   b. Labor: NA
9. Installation Labor
   a. Parts: NA
   b. Labor: 1 year

C. All warranties are based on VRCs being properly used and maintained as outlined in the respective supplier's operations manuals.

1.09 SPARE PARTS

A. Supplier to provide recommended list of spare parts at program inception.
   1. Spare parts matrix, identifying recommended spare parts for each unit by type, shall be submitted to, reviewed, and approved by Tenant CM/ Tenant RME.
   2 .Spare parts matrix shall be submitted on the Tenants "VRC Spare Parts" form. See section 1.03 references for template.
   3. Spare parts matrix shall include consumable items such as touch up paint, etc.

B. Spare parts ordered routinely shall be provided as a kit versus individual components.

C. Spare parts package(s) shall arrive on site 21 days prior to First Receive date.
   1. Spare parts packages are required to be identified according to the Tenants "VRC Spare Parts" shipping standard, which includes requirements for identification of the spare parts packages/pallets, inventory for each package shipped, addressing, and shipment tracking.

D. Supplier to inventory each spare parts package prior to shipping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Autoquip: www.autoquip.com Contact:
Louis Coleman
1058 West Industrial, Guthrie, OK 73044
(405) 282-5200
lcoleman@autoquip.com

B. Gebhardt Fördertechnik GMBH: www.gebhardt-foerdertechnik.de/en Contact:
James Kappele
3487 Center Rd., Brunswick, OH 44212
(216) 650-1000
j.kappele@gebhardtusa.com

C. PFLOW Industries: www.pflow.com Contact:
Chuck Cobb
6720 N Teutonia Ave., Milwaukee, WI 53209 (414) 352-9000
chuckc@pflow.com

D. Wildeck: www.wildeck.com Contact:
Dave Milner
405 Commerce St., Waukesha, WI 53186
(262) 522-2030
dmilner@wildeck.com

E. Substitutions: Not permitted unless under special circumstances.

2.02 OPERATIONAL SPECIFICATIONS

A. VRC shall be designed for loading freight via various forms of storage capacity. Current manual loading consists of using utilizing pallet jacks, carts, pallets or juice carts. VRCs must not be loaded with heavy equipment such as forklifts or other powered industrial trucks.

2.03 DESCRIPTION

A. VRC-POD Transfer (applicable to ARS program only):

1. Model:
   a. Autoquip: FLMC-6
   b. Gebhardt: ConVer 150-2

c. PFLOW: F Series

d. Wildeck: 4DM

2. Live Load Capacity: 3,500 lbs.
3. Lifting speed when loaded to capacity: 50 feet per minute
4. Platform Minimum Clear Size: 48 inch wide x 117 inch deep, nominal
5. Platform Clear Height: 107 inch minimum
6. Mounting: Pit
7. Carriage Doors: Single Swing
8. Enclosure Door: Single Swing.

B. VRC-Small (applicable where SLAM & Platforms exist in Programs: ARS, IXD, OXD & SSD DC):

1. Model:

a. Wildeck: DL-2200

b. PFLOW: SL-2500

2. Live Load Capacity: 2,200 lbs.
3. Lifting speed when loaded to capacity: 16 feet per minute
4. Platform Size: 60 inch wide x 72 inch deep, nominal
5. Platform Clear Height: 84 inch minimum
6. Mounting: Surface mounted with diamond plate approach ramp
7. Carriage Doors: Single Swing
8. Enclosure Door: Single Swing

C. VRC-Large (applicable to ARS,TNS & Hazmat):

1. Model:

a. Autoquip: FL4M-6

b. CIP: AFC-AD6

c. Gebhardt: ConVer 150

d. PFLOW: F/HF Series

e. Wildeck: 4DM

2. Live Load Capacity: 5,000 lbs.
3. Lifting speed when loaded to capacity: 50 feet per minute
4. Platform Size: 119 inch wide x 117 inch deep, nominal
5. Platform Clear Height: 80 inch minimum
6. Mounting: Pit
7. Carriage Doors: Roll-Up-Door
8. Enclosure Door: Roll-Up-Door

D. VRC-XL (applicable to ARS program only)

1. Live Load Capacity: 5,000 lbs.

2. Lifting speed when loaded to capacity: 50 feet per minute
3. Platform Size: 119 inch wide x 145 inch deep, nominal
4. Platform Clear Height: 107 inch minimum
5. Mounting: Pit
6. Carriage Doors: Roll-Up-Door
7. Enclosure Door: Roll-Up-Door

E. Design cycles per year: 80,000

F. Vertical travel, stops, door positions, loading pattern, dimensions: As indicated on drawings.

2.04 STRUCTURAL SPECIFICATIONS

A. Mast Design: The VRC shall be a 4 point lifting for large and 2 point lifting for Small and POD, and supporting structure.

1. The carriage shall not shake, rock, or vibrate at all levels independent of load.

B. Deflection: No portion of the VRC shall exhibit permanent deflection of any kind under uniform or non-uniform live loads.

1. Temporary allowable deflection (due to loading) of ¼ inch.

C. Seismic Design: The VRC design shall be in compliance with seismic site class D unless more restrictive requirements are indicated on Structural drawings.

D. The VRC mounting (pit or on slab with ramp):

1. Pit dimensions illustrated on drawings

2.05 MECHANICAL SPECIFICATIONS

A. Acceleration and deceleration speed of 0.5 ft/s² from at rest position independent of load; both a soft start and stop.

B. Maximum settling time ≤ 2.5 seconds per level; independent of the load.

C. Carriage position at each level, including ground level, shall maintain a flushness tolerance of ± 1/4 inch per level independent of load; referenced from the centerline of the carriage

D. Lift Carriage:

1. Additional clear height requirements shall be ultimately governed by the local jurisdiction.
2. Side Panels:
   a. Shall be a full load height of 80 inch covered with 16-gauge solid sheet metal skin or 16-gauge galvanized metal comprising an embossed tread pattern.
   b. Rub rail along the lower edge of the platform panels shall be constructed of ¼ inch thick UHMW at 8 inch high rub rail shall also exist along the midsection of the carriage walls.
3. Safety Stops:
   a. The lift carriage shall be equipped with broken lifting device stops that prevent the carriage from descending more than 6 inch in the unlikely event of a failure.
4. Lifting Means/Drive System:
   a. The drive system shall be of a mechanical design with electric brake motors.

1) Mechanical lifting design shall be designed as a minimum of 10 times safety factor for wire rope and a 7 times safety factor for chain.

2) The electrical drive motors shall be 100% duty cycle with a failsafe brake while the reducers must be certified with an AGMA Class-3 rating.

3) If multiple motors are used, the lifting force shall be equally distributed across each motor.

4) If a NORD drive system is utilized with multiple motors, then the motors shall be programmed referencing power versus location.

5. Safety Devices:

a. The drive system shall be equipped with slack cable/chain sensors or switches to disable motor power in the event a cable/chain becomes slack.

b. The drive system shall be equipped with cable/chain tension sensors that will disable motor power in the event of an off center and over travel condition.

c. The carriage shall have a means of being mechanically locked out (at each upper level) while the carriage is in a raised position for the purpose of maintenance access in and around the platform. This mechanical locking device shall be able to be engaged automatically from the HMI screen at the controller and shall be available to land the carriage at each floor and with the carriage 8’ above the ground floor.

E. Carriage Doors:

1. Platform Roll-Up Door (RUD):

a. Manufacturer: Hormann: Model: SR9000L

1) Substitutions: Not permitted.

b. Motorized High-Speed, High Performance Rolling (Roll-up) Steel Platform Door(s):

1) Door Style: The door shall be motorized high-speed as well as high performance rolling steel; equipped with electrical and mechanical locking devices. Devices shall be supplied on all operating sides of the VRC at each level of operation.

2) Drive System: The drive system shall be a direct drive, springless design.

3) Operation Speed: The RUD must meet an opening speed of 30 - 36 inch per second with a closing speed of 20 inch per second.

4) Integral Light Grid/Curtain: A built-in light grid embedded in a low-profile guide track is required to protect personnel and goods from coming into contact with the door. Light beams shall shine across the door opening. If a beam is interrupted while the door is closing, then the door will come to a stop and automatically open back up.

(a) The light curtain must capture the lowest point of a door opening, specifically being < 1 inch from the bottom of the floor.

(b) At minimum, the light curtain must have sensors placed every 1 inch until the max clear height.

5) Durability: Decotherm® 29-gauge steel panel slats (standard color: RAL 9006) are constructed of a polyurethane core; covered with a triple layered skin consisting of: an inner galvanized layer surrounded by an outer steel sheet layer, then covered by another galvanized layer, concluding with the surface finish.

6) Visibility: Double pane windows shall be provided for visibility. Windows shall be located at a minimum of 52 inch from the bottom of the door and no higher than 72 inch.

7) Door Operation: Doors shall open and close utilizing the integrated open/close pushbuttons on a call station.

8) Bypass: All motorized doors shall have an emergency, manual bypass in the event a person becomes entrapped inside the VRC with no power.

(a) This shall be accomplished with simple pull chains, a manual hand-crank, or a combination of the two.

9) Landing Frame Support: Bracing structures to support the landing frame door to a storage platform shall utilize a bolted connection versus weld.

10) Magnetic Interlock Switch: The RUD magnetic interlock switch shall be located between the RUD and carriage platform to alleviate operational abuse.

2. Swing Gate Style:

a. Single swing style gates shall be supplied on all operating sides of the VRC at each level of operation.

b. Gates shall utilize a robust, adjustable hinge design.

1) All door components shall be strong enough to support the weight of the door, defined operational use and specified cycles.

2) Hinge shall not allow gates to sag.

3) Shall operate with < 18.7lbs force.

4) Locking Mechanism: The Swing Gate must be equipped with an electrical and mechanical locking device to prevent opening the gate; unless the carriage is present, and to prevent operation unless all gates are closed.

(a) The locking mechanism shall be an electromechanical interlock device either activated by a roller and cam or activated by a solenoid.

(b) A gate shall be released when the carriage is in position. If the solenoid operator is used the operator will press the current level push button on the call station.

(c) The solenoid shall remain activated, specifically holding the interlock open, for a minimum of 8 seconds after the button is pressed.

(d) The cable connecting the solenoid to the interlock shall be guarded and easily maintained by removal of the guard.

(e) The solenoid housing shall be protected with a secondary panel requiring a tool to remove.

3. Locking Mechanism: Regardless of style, a RUD or Swing Gate must be equipped with an electrical and mechanical locking device to prevent opening the door/gate; unless the carriage is present, and to prevent operation unless all gates are closed.

F. Enclosure / Guarding Specifications

1. Safety Enclosures: Guarding is required on all non-operating sides of the VRC at each level of operation. Wire mesh rejecting 1/2 inch diameter ball. Enclosures shall be supplied as follows:
2. Enclosure Panels
   a. Three types of Enclosure Panels are required as follows:
      1) Enclosure panels shall extend 96 inch high at minimum and are required on all non-operating surfaces on the ground floor.
      2) Wing panel enclosures shall extend 96 inch high x 48 inch wide at minimum and are required on each floor at the bi-parting swing gates or RUDs.
      3) Back stop panels shall extend 96 inch high at minimum and are required on all levels beyond the ground floor.
3. Enclosure Gates
   a. The RUD enclosure gate shall be electrically interlocked and will not allow carriage movement unless the gates or door is closed.
   b. The manual style Single Swing or Bi-Swing gates will require an Electrical and Mechanical Locking Mechanism.
      1) The locking mechanism shall be an electromechanical interlock device either activated by a roller and cam or activated by a solenoid.
      (a) A gate shall be released when the carriage is in position. If the solenoid operator is used the operator will press the current level push button on the call station.
      (b) The solenoid shall remain activated, specifically holding the interlock open, for a minimum of 8 seconds after the button is pressed.
      (c) The cable connecting the solenoid to the interlock shall be guarded and easily maintained by removal of the guard.
      (d) The solenoid housing shall be protected with a secondary panel requiring a tool to remove.

2.06 ELECTRICAL SPECIFICATIONS

A. Basic voltage requirement:

1.480V, 3 Ph, 60 Hz.

B. Electric Motors:

1. Motors shall be an electromechanical design.

2. Motors shall be 100% duty cycle comprising an electric brake while the reducers must be certified with an AGMA Class-3 rating.
    a. The motors shall have a minimum duty cycle of 100%.
    b. Motor mechanical lifting design shall provide for a minimum of 10 times safety factor for wire rope, and 7 times safety factor for chain
3. Motor horsepower shall be sized to handle the carriage weight in addition to the rated live load and specified speed.
4. Motors shall be designed for continuous duty at ambient temperatures ranging from 32° to 102° Fahrenheit.
5. Motors shall restart via pushbutton at the control cabinet when the overload device is reset.
6. Each motor shall be equipped with a heavy-duty, long life, fast-acting fail-safe disc brake to ensure the brake will hold in the event of a power failure.
7. Gear reducers shall be a mechanical design; fully compatible with the motors using grease or synthetic lube, sealed for life.

C. Controls:
1. The control voltage shall not exceed 24V.
2. Control Stations
    a. Each operating floor shall be equipped with a light-present momentary contact push- button control station with the following functions:
        1) Call/Send push buttons for each floor. Button shall light green when activated.
        2) Mushroom style E-stop switches with red light illuminated once engaged.
        3) Fault indication per floor shall be included.
3. Future Tenant integration with the control cabinet will be required to collect overall equipment effectiveness (OEE) data.
4. RUD control box needs to be at same level as push button station (PBS) if possible.

D. Control Panel:
1. An internally pre-wired, NEMA 12 rated control panel shall be provided with an appropriate transformer, overload relay, field wiring terminal block and appropriate breakers. The control panel will have the ability to be locked with a unique key or through a hasp lock on the controller door.
2. The control panel shall be located on the ground level and accessible from the exterior.
    a. Actual location to be verified and approved by Tenant CM.
3. The control panel shall be equipped with a HMI displaying information related to fault conditions, run history, and alarms for troubleshooting purposes.
    a. The HMI shall be equipped with double password protection to limit user access capabilities. Level one will be limited access and Level two will allow full access. Once VRC had been VQ'd and state inspected (if required) passwords must be changed. Passwords must come from OEM. Tenant RME and OE may have access to level one passwords and VRC OEM will have access to level two

passwords. Tenant VRC program managers will maintain database of level two passwords provided by OEM.

b. The HMI shall inform a user the location of each fault condition or alarm; i.e.,the location of a failed RUD proximity switch or engaged E-stop.

c. PLC/HMI program version should be displayed on/in the HMI.

4. The control panel shall be equipped with a key switch and encompass the following functions:

a. Auto (normal)

b. Maintenance mode – key to be removed from the control panel or passcode to be entered at the HMI of the control panel to initiate maintenance mode.

1) When in maintenance mode, the control panel overrides all call station controls including doors, which shall be able to open for servicing or repairs.

c. All fault indicators (lights or HMI) to be located on outside of panel with full legend.

d. External data port shall be provided for laptop access and troubleshooting.

5. Control schematics shall be supplied inside each control panel. Schematics to include control panel device layout with BOM and VRC device layout with BOM.

6. All wiring inside control panels, PBS (push Button Stations) and RUD control panels for external wiring, to be numbered per OEM electrical drawings.

7. Overall machine electrical device layout w/BOM.

E. Soft-Start / Soft-Stop – The VRC shall be equipped with a variable frequency drive which provides smooth acceleration and deceleration as well as accommodate a full load with cable/chain stretch. Please reference Mechanical Specifications for acceleration and deceleration values.

F. Limit/Proximity Switches – The VRC shall be equipped with a floor level, upper level, and over travel limit switch at each level to provide precise positioning of the carriage.

1. Limit/Proximity switches shall be accessible from outside of the enclosure panels for adjustments, preferably by foot from the raise storage platform.

2. Access shall be protected by a panel which requires tool access.

G. Slack Condition Safety Switches - Switches shall be provided to monitor slack condition and disable the power to the motor while engaging carriage safety brakes in the event of a slack chain/cable condition or broken lifting device.

H. Cable Management

1. All internal and external cabling to be run parallel and perpendicular.

2. Appropriate wire ways shall be used for all cabling; Hellerman Tyton or equivalent.

3. All cabling shall be shielded. High and low voltage cables shall be run in separate conduit/electrical troughs.

4. All cabling shall be screwed to frame using P Clips. No adhesive means of attachment shall be used.

5. All external wiring into push button stations (PBS) must be numbered per the OEM electrical drawings.

I. Carriages shall be provided with mechanical lock out devices at each upper level, which will lock the carriage in a raised position for maintenance access.

2.07 MATERIALS AND FABRICATION

A. Gates, Platform (Carriage) and Threshold:

1. Gates shall be sized to accommodate an 80 inch clear access height to the platform.
   a. Swing gates shall not exceed a height of 79 inch in order to clear overhead obstructions, i.e., conveyor, at landings.
2. Gates and perimeter guarding shall be fabricated from 1-1/4 inch square 11-gaugesteel tubing; at minimum, covered with a 1/2 inch #13 flattened expanded metal skin.
3. Platforms shall have a rub rail along the lower edge of the platform panels. Rail to be constructed of 1/4 inch thick UHMW 8 inch high.
   a. POD Floor guides to be included in POD VRC
4. Any operator access points such as knobs, grip points, handles, etc. shall have a flat, smooth surface in place of expanded metal to prevent any catch/pinch points.
5. Threshold plates shall be fabricated from a single continuous 1/4 inch steel plate.
   a. The contact edge facing the platform shall incorporate a rounded bullnose design.
   b. The threshold shall be continuously welded and anchored to the raised storage platform.
   c. The thresholds and wood/fiber/resin deck floors must be thru bolted through the B deck using a steel backer plate of at least 1/4" thickness. Lock nuts must be used. Do not use lag screws. OEM recommended fasteners.

B. Fit - Gates and Carriage:

1. Maximum gap between doors (gates) when closed shall be equal to 1/2 - 3/4inch.
2. Maximum gap between doors and a RSP floor shall be equal to 1inch.
3. Gapping on all gates shall be consistent and uniform.
4. Door (gates) on the platform (carriage) and the landing area shall be aligned along same centerline when installed.
5. Allowable range of lateral gapping between platform (carriage) and raised storage platform:
   a. Minimum = 1/2 inch , Maximum = 3/4 inch
   b. Lateral gapping shall be uniform throughout the opening.
6. Allowable range of lateral vertical tolerance between platform (carriage) and raised storage platform = 1/4 inch.

2.08 FACTORY FINISHING

A. All carbon steel surfaces including shafts and sprockets need to have corrosion resistant coating applied at OEM facility prior to shipping to protect the unit from corrosion.

B. Interior lift carriage shall be powder coated to a minimum 4 mil thickness for wear resistance.

1. A combination of polyurethane paint or galvanized material to 4 mil thickness is permitted upon Tenant approval.

C. All other carriage and enclosure surfaces shall be either painted or powder coated to a minimum of 2 mil thickness.

D. Powder coating or paint colors shall comply as follows:

1. The manufacturer's standard color will be the expected standard.
   a. Tenant has selected manufacturer's standard colors:
      1) Autoquip: Autoquip Blue
      2) CIP: Anthracite Gray
      3) Gebhardt: 7043 RAL Grey
      4) PFLOW: PFLOW Blue
      5) Wildeck: Gray
   b. A color chip RAL shall be provided to Tenant for approval in the case of an abnormal color
2. Safety yellow shall be used on the following components:
   a. Header/Track Rail
   b. Threshold Plate
   c. Corner Posts

E. Touch up paint of each color shall be provided.

F. Prior to applying the finish, all dirt, mill scale, oil and grease shall be removed from carbon steel surfaces by a combination of brushing, wiping and use of solvents.

G. All mechanical surfaces shall be properly coated; i.e., zinc, galvanize, anodize, etc…

2.09 ACCESSORIES

A. Safety signage required as per Tenant WHS standards.

1. Comply with Tenant's latest issued VRC signage package.
2. This includes, but is not limited to, the following:
   a. NO RIDERS' signage posted at every door and inside every carriage. Lettering shall be a minimum of 2 inch high for visibility.
   b. All other signage shall meet the minimum requirements set forth in the VRC application guidelines set forth in ASME B20.1
   c. Operational instructional signage posted at every door.
   d. Warning: Fast Moving Door' signage posted at every high-speed RUD.
   e. In Case of Emergency: Roll-up Door Manual Bypass' signage posted at every RUD.

1) Required inside the carriage and at the crankshaft opening on the RUD's shroud.

f. 'Warning: Do Not Disassemble Gearbox' signage posted on each gearbox at the top of an upright.

g. VRC #, as applicable, signage labeled at each call station and each control panel and disconnects.

h. Standard arc flash and shock hazard warning labels

i. All other signage required by applicable codes, and Owner requirements.

B. Provide fall protection safety straps at each gate opening, for use in gate or lift maintenance-safety straps and safety strap anchorage design strength shall be as required by Code. Access to all safety devices/ safety device enclosures shall be from outside the platform.

C. VRC Weight Overload Detection System:

1. Applies to: VRC-Large.

2. Each floor shall be equipped with an amber and red indicator light combined with audible alarm near the VRC operational control buttons.

a. When load to carriage exceeds 4500 pounds the amber light shall activate notifying the operator the VRC has reached 90% capacity.

b. When load to carriage reaches or exceeds 5000 pounds the red light and audible alarm shall activate notifying the operator the VRC has exceeded 100% capacity.

1) A device shall log the overload event and prohibit operation until the excess weight is cleared and accumulate the total of these events for data collection purposes.

c. If the VRC load is unbalanced where the safe operation of the VRC may be compromised the red light and audible alarm shall activate.

1) A device shall log the unbalanced event and prohibit all operation until the load is adjusted to safe condition and accumulate the total of these events for data collection purposes.

d. Once the excess load has been reduced to a safe weight the red light and audible alarm shall deactivate and return to Amber or no notification whichever is appropriate for the current load.

e. Once the unbalanced load has been corrected the red light and audible alarm shall deactivate and return to Amber or no notification whichever is appropriate for the current load.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to commencing fabrication and installation of any VRC, the supplier and installer shall visually examine the site conditions under which the VRC is to be installed in order to verify the following:

1. Fit and clearance of a unit

2. Identification of any obstructions

3. Verification of pit dimensions and location
   a. In verifying a pit location, the supplier and installer must reference the most protruding edge of a storage platform utilizing a plumb bob or laser device to pinpoint the front edge of each pit.
4. Identification and confirmation of accessibility, dock usage, and lay down space.

B. Supplier shall notify the Tenant CM and VRC Program Manager(s), in writing, of conditions detrimental to the proper and timely completion of the work as well as identify any obstructions to the VRC envelope.

3.02 INSTALLATION

A. Supplier Responsibilities:

1. Provide installation training to the installation crew.
   a. A standard installation drawing package shall be provided to the installer and Tenant, articulating all structural, mechanical and electrical requirements to install the VRC.
      1) The drawing package shall entail all field welding criteria along with the location and tolerances of all field mounted devices.
2. Ensure all installation personnel have appropriate safety training.
3. Provide drawing and information including the following:
   a. Unloading instructions
   b. Storage guidelines
   c. Mechanical installation instructions
   d. Electrical installation instructions
   e. Commissioning instructions
   f. Testing instructions
4. Provide all VRC equipment and installation materials.
   a. No VRC material is to be stored outside unprotected from the weather. Storage trailer is recommended.
5. Provide professional and expert support to installers during installation.
   a. VRC OEM supervision must be present during installation.
6. Inspect and verify the VRC meets all project specifications.
7. Provide project schedule and updates to comply in completing the overall installation by the First Receive VQ date.

B. Installer Responsibilities:

1. Installer must comply with the manufacturer’s detailed mechanical and electrical installation instructions for proper installation.
2. Installer to conduct work in a safe manner and shall comply with all site specific safety standards.
   a. Greenfield sites are covered by the general contractor’s safety standards and may vary from site to site.

b. Live facilities are covered by Tenant WHS standards which are used network-wide.

3. Installer shall provide all tools and equipment required for proper unloading, rigging, assembly, and installation of VRC equipment.
4. Installer shall be responsible formaintaining the condition of the equipment and material while stored on site.
5. Installer shall maintain a clean and orderly work environment; including at a minimum:
   a. All work areas to be broom swept daily
   b. All shipping and packing materials to be removed from the working area and disposed of properly
   c. All excess materials to be removed from the working area and disposed of properly
6. Installer shall match-mark all torque rated fasteners.

C. General Contractor Responsibilities:

1. VRC shaft shall be constructed to accommodate VRC equipment (troughing, venting, and hall fixtures).
2. Provide and install a steel safety beam per VRC, from side wall to side wall at the top of the hoist way, capable of withstanding a maximum net live load of 5000 lbs. 2” clear above the beam is required.
3. Provide a clear plumb hoist way with variations from the size shown on the installer layout not to exceed –0 inch / +1 inch.”
4. Furnish adequate rail/tower support steel to tie VRC back into building structure.
5. Furnish a pit reinforced to sustain vertical forces of VRC. The pit must be dry and clean.
6. Provide onsite refuse containers for disposal of VRC packing material during entire installation period.
7. VRC pit construction necessary to accommodate the lift.
8. Steel plate angle at threshold for all VRC openings, fundamentally to facilitate threshold welding.
9. Ensure installer has proper access and dock usage at site. Suitable semi-trailer access to the building for unloading of material. Roll-able access from unloading point to hoist way area is required. Any temporary flooring or wall protection for the building will be provided as well.
10. Provide suitable, dry, and secure on-site storage, approximately 30’ x 30’ per VRC adjacent to the hoist way on the first level. No VRC material is to be stored outside unprotected from the weather. Storage trailer is recommended until interior dry space is available.
11. Provide 120v 20 amp temporary power within 75ft of each hoist way. Additionally, provide 240v temporary power within 15 feet at each hoist way for welding. These must be available once installer arrives on site.
12. Provide lifting beams for hoisting and rigging.

13. All handrail/kick plate cutting modifications necessary to accommodate VRC installation.
14. As required by law, a freestanding removable barricade at each hoist way opening at each floor. Barricades shall be 42” high, with mid-rail and kick board, and withstand 200 lbs of vertical and horizontal pressure. Full entrance screening/mesh in front of all VRC entrances or Secured / controlled access to all VRC lobbies (lock and key) with posted Notice “only VRC personnel beyond this protection. Hoist way barricades and screening shall be constructed, maintained and removed by General Contractor.
15. Provide 480v 3 phase electrical feed and lockable disconnect switch to be located within 10’ of the control panel, and conduit with electrical feed to VRC controller. Sized in according to VRC manufacturer guidelines.
16. Provide carriage protection once VRC is turned over. Protection will be removed around first receive date. To be constructed with a minimum of 2”x4” frame with a 1/2” plywood. Blanket is not sufficient.

3.03 FIELD QUALITY CONTROL

A. Installation quality is ultimately a responsibility of the VRC supplier. Oversight of installation quality is to be accomplished by Supplier, Tenant CM, VRC Program Manager or designated Tenant representative.

B. Intent is to ensure safety and quality.

C. Either party is empowered to stop any, or all work, if conditions detrimental to quality control or safety are found.

3.04 INSTALLATION INSPECTION/REPORTING

A. The General Contractor is responsible for providing periodic inspection and reporting on the installation of VRCs. They may select an VQ inspector at their discretion or use the approved inspector listed below. The cadence of reports, that need to be provided to the VRC program manager, will be a preliminary survey, 40% schedule completion, 80% schedule completion and Final VQ. VRC manufacturer will be present per the cadence contracted with the VRC installer and must be at the Final VQ Inspection. Tenant Operations Engineering must be present at the Final VQ Inspection. Manufacturer and VRC specific templates are available via the VRC program manager and must be used during the process.

1. Approved Inspection/Reporting Vendor – Reference 1.04 Contracting Requirements for contact information.

3.05 OPERATIONAL PERFORMANCE TESTING

A. Upon completion of installation, the following tests shall be conducted by the supplier witha Tenant representative for validation and verification of proper operation:

1. Operating Load Test: The Contractor will provide a test load of specified live load capacity and load the VRC at the lowest level. The loaded VRC carriage shall be conveyed to an upper floor level and returned to the lowest level to assure proper operation.
2. Performance Test: This test shall be performed in conjunction with Test 1 above. During the demonstration of the lifting and lowering test, the Contractor

shall measure the time required to lift and lower the load. The VRC shall perform at the speeds identified

3. Stationary Load Test: This test shall be performed in conjunction with Test 1 above. The loaded VRC carriage shall remain stationary at an upper level for a minimum of one (1) hour. After the one (1) hour period, the VRC will be inspected for deflection of the components or drift of the platform.
4. POD Lift Stress Test: This test shall be performed following the successful conclusion of Tests 1, 2 and 3 above. POD Lift Stress testing is an operational test which mirrors performance requirements of the POD Lift in service, and is performed sequentially the on POD Lifts during a performance period of 6 working days. During the testing, the contractor shall follow the requirements of Tenants POD Lift Stress Testing standard, including all loading, lift cycling, sequence or operation, measuring and reporting requirements. Final operational test reports indicating successful completion of the tests are required, in the reporting format specified in the Tenant standard.

3.06 ACCEPTANCE

A. Upon completion of installation and operational performance testing, Supplier and Tenant shall jointly verify the equipment is properly installed in accordance with the manufacturer's guidelines and guarded to meet or exceed all governing specifications.

B. Punchlists shall be generated with the Installer, Supplier, and TenantOperations Engineering. Scheduling of punchlist completion will be as follows:

1. All safety related items, immediate correction required.
2. All operational related items, to be corrected prior to building launch.
3. All other items, to be corrected in 2 weeks.
4. Issues discovered during the short term period of operation shall be corrected in 1 weeks' time
   a. Short term refers to the first 60 days of operational use.
5. Issues discovered during the long term period of operation shall be corrected by warranty in 2 weeks' time.
   a. Long term refers to 60 plus days of operational use.

C. Training of the VRC units shall be provided prior to building launch detailed as follows:

1. Operational Training
   a. All operational manuals shall be provided at time of operational training.
2. Maintenance Training; including troubleshooting and repair
   a. All maintenance manuals shall be provided at time of maintenance training.
3. Training will be provided in compliance with a train-the-trainer approach.

3.07 CLOSE OUT

A. Clean: Excess/extra materials shall be removed from site. Remove and dispose of all rubbish and debris caused by the work under this section.

B. Touchup: Installer shall touch-up all scratches, abrasions, and other defects in the pre-finished surfaces with the same material color and type of finish or equivalent as used at time of fabrication.

C. Stand by support shall be provided by supplier and installer for a period of one week.

1. Support shall start 2 days prior to the building Go Live date.
2. Any issues found during, and prior to standby support shall be corrected prior to the Go Live date.

END OF SECTION 144551

9. Rated Speed: 150 feet per minute.
10. Hoistway Size: As indicated on drawings.
11. Interior Car Platform Size: As indicated on drawings, sized to accept gurney straight in.
12. Elevator Pit Depth: 60 inch.
13. Overhead Clearance at Top Floor: 154 inch.
14. Travel Distance: As indicated on drawings.
15. Number of Stops: As indicated on drawings.
16. Number of Openings: As indicated on drawings
17. Hoistway Entrance Size: 4 foot wide x 7 foot high
18. Door Type: Two Speed Side Opening
19. Operation: Microprocessor Single Car Automatic Operation
20. Guide Rails: Equivalent to 12 lb. per foot
21. Power Supply: 208 Volts 3 Phase 60 Hz

C. Performance:
1. Car Speed: -10% to +5% of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 125% of rated load per code.

D. Ride Quality:
1. Vertical Vibration (maximum): 25 mg
2. Horizontal Vibration (maximum): 15 mg
3. Vertical Jerk (maximum): 2 ft/sec^3
4. Acceleration (maximum): 1.6 ft/sec^2
5. In Car Noise: 53-60 dB(A)
6. Stopping Accuracy: ±5mm
7. Starts per hour (maximum): 180

E. Elevator Operation:
1. Simplex Collective Operation: Using a microprocessor based controller, operation shall be automatic by means of the car and hall buttons. When all calls have been answered, the car shall park at the last landing served.
2. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching algorithm designed to minimize passenger waiting time.

F. Operating Features - Standard:
1. Door Light Curtain Protection
2. Static AC Drive
3. Phase Monitor Relay
4. Cab Overload with Indicator
5. Load-weighing
6. Central Alarm
7. Remote Monitoring
8. Firefighter's Operation
9. Independent Service

G. Operating Features - Optional:
1. Shunt Trip Protection

2.03 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

A. Controller: Provide microprocessor based control system to perform all of the functions of safe elevator operation, as well as perform car and group operational control.
1. All high voltage (110v or above) contact points inside the inspection and test panel shall be protected from accidental contact in a situation where the access panels are open.
2. The controller shall be distributed throughout the elevator system located in the overhead, cab and inspection and test panel. The inverter will be mounted in the overhead adjacent to the hoist machine and an inspection and test panel will be located in the door jamb at

the top floor or one floor below the top floor. No elevator equipment mechanical rooms or closets are required.

3. Provide multi-bus control architecture to reduce cabling, material and waste.

B. Drive: Provide a Variable Voltage Variable Frequency AC Closed Loop drive system. Provide stable start without high peak current, quickly reaching a low energy consumption level.

C. Inspection and Test Panel: Integrated control equipment, main inspection and test panel in door frame at top level served or at one floor below the top level served.

2.04 EQUIPMENT: HOISTWAY COMPONENTS

A. Machine:
1. Gearless asynchronous AC motor with integral drive sheave, service and emergency brakes.
2. Design machine to enable direct power transfer, thereby avoiding loss of power.
3. Design machine to be compact, lightweight and durable to optimize material usage and save space.
4. Mount to structural support channels on top of guide rail system as applicable in hoistway overhead.

B. Governor:
1. Tension type over-speed governor with remote manual reset.
2. Mount to structural support channels as applicable in hoistway overhead.

C. Buffers, Car and Counterweight: Compression spring type buffers to meet code.

D. Hoistway Operating Devices:
1. Emergency Stop switch in the pit.
2. Terminal stopping switches.
3. Emergency stop switch on the machine.

E. Positioning System: System consisting of proximity sensors and door zone vanes.

F. Guide Rails and Attachments: Provide Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Suspension System: Non circular, fire resistant, elastomeric coated suspension media with high tensile grade steel cords.

H. Governor rope: Steel wire rope with 6 mm diameter.

2.05 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoistway Doors and Frames:
1. UL rated with required fire rating.
2. Doors: Rigid flush panel construction with reinforcement ribs.
3. Frames: Securely fasten at corners to form unit frame. Frames shall be bolted.

B. Finish:
1. Exposed Areas of Corridor Frames: Brushed stainless steel. - All Floors
2. Doors: Brushed stainless steel.
3. Sills: Aluminum - All Floors

C. Entrance Markings and Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.06 EQUIPMENT: CAR COMPONENTS

A. Car Frame and Safety: Provide car frame with adequate bracing to support the platform and car enclosure. The safety shall be integral to the car frame and shall be flexible guide clamp type.

B. Platform: Provide platform of steel construction with plywood subfloor and aluminum threshold.

C. Car Guides: Provide sliding guide shoes mounted to top and bottom of both car and counterweight frame. Arrange each guide shoe assembly to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

D. Provide central guiding system to reduce mechanical friction and energy consumption.

E. Steel Cab:
   1. Fire rating: Provide Class B fire rating for cab, or Class A fire rating where required by local Code.
   2. Car wall finish: Plastic Laminate selected from manufacturer's standard selections.
   3. Base and frieze: Aluminum.
   4. Car front finish: Brushed stainless steel.
   5. Car door finish: Brushed stainless steel.
   6. Ceiling: Canopy ceiling, finished in #4 Stainless Steel With Down Lit Led Lighting. Provide lighting consisting of four LED lights located in two semi-oval lateral cutouts located on the center-sides of the cab ceiling, Lexan lens cover.
   7. Handrail: Straight Rectangular Brushed Aluminum. Locate on Side Walls.
   8. Flooring: As indicated on drawings. Not to exceed 3/8" finished depth.
   9. Ventilation: Provide one-speed fan in canopy.
   10. Emergency Car Lighting: Provide an emergency power unit employing a 12 volt sealed rechargeable battery and static circuits to illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
   11. Emergency Siren: Provide siren mounted on top of the car that is activated when the Alarm button in the car operating panel is engaged.
   12. Emergency Exit Switch: Provide an electrical contact to open the safety circuit when the emergency car top exit is opened. When the exit door is opened, the top exit switch shall signal the control and the car will be unable to move.
   13. Emergency Exit Lock: Provide an emergency exit lock where required by local code.
   14. Emergency Exit Guard: Provide emergency exit guard on top of car when required for hoistway wall to platform clearance exceeds 12" or for multiple cars in hoistway.

2.07 DOOR OPERATOR AND REOPENING DEVICES

A. Door Operator: Provide a closed loop VVVF high performance door operator with frequency controlled drive for fast and reliable operation to open and close the car and hoistway doors simultaneously.

B. In case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Provide emergency devices and keys for opening doors from the landing as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. Provide door open button in the car operating panel. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Provide door hangers and tracks for each car and hoistway door. Contour tracks to match the hanger sheaves. Design hangers for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed for life bearings.

E. Electronic Door Safety Device: Equip car doors with concealed transmitter and receiver infrared beam devices to detect presence of object in process of passing through hoistway entrance and car doorway (light curtain device).
   1. Use multi-beam scanning without moving parts to detect obstructions in door opening.
   2. Detector Device: Prevent doors from closing, or if they have already started closing, cause doors to reopen and remain open while object is within detection zone.
   3. Horizontal Beams: Minimum of 33 infra red beams to fill doorway from ground level to a height of 6 feet.

2.08 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide a car operating panel with all push buttons, key switches and message indicators for elevator operation.
   1. Full height car operating panel shall be surface-mounted on front return, front and rear return on elevators with double doors.
   2. Comply with handicap requirements.
   3. Push Buttons: Mechanical, illuminating using long-lasting LEDs for each floor served.
   4. Emergency Buttons: Provide in accordance with code. Emergency alarm button, door open and door close buttons.

B. Features of the Car Operating Panel Shall Include:
   1. Audible chime to signal that the car is either stopping at or passing a floor served by the elevator.
   2. Raised markings and Braille provided to the left hand side of each push button.
   3. Car Lantern: Provide LED illuminated car lantern with direction arrows to comply with local code when hall lanterns are not provided.
   4. Door open and close push buttons.
   5. Firefighter’s hat and Phase 2 Key-switch
   6. Inspection key-switch.
   7. Key-switch for optional Independent Service Operation
   8. Illuminated alarm button with raised marking.
   9. Elevator Data Plate marked with elevator capacity and car number.
   10. Help Button: Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.

C. Hall Fixtures: Provide hall fixtures with necessary push buttons and key switches for elevator operation.
   1. Push buttons: Metallic tactile push buttons, up button and down button at intermediate floors, single button at each terminal floor.
   2. Height: Comply with handicap requirements.
   3. Illumination: Illuminating using long-lasting low power LEDs.

D. Hall Lanterns and Position Indicators.
   1. LED illuminated direction arrows with audible and visible call acknowledgement.

E. Hoistway access switches: Provide key-switch at top and/or bottom floor in entrance jamb as required by local code.

F. Firefighter’s Phase 1 Service: Key switch in brushed stainless steel cover plate.

G. Fixture Cover Plates: For push buttons, hall lanterns and position indicators, resistant white back-printed glass, no screws required for mounting. Provide stainless steel cover plates for Firefighter's Phase I switch and hoistway access switches, with tamper resistant screws in same finish.

H. Mounting: Mount hall fixtures in entrance frames.

2.09 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

B. Accessibility Requirements: Comply with ADA Standards.

C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.

D. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
   1. Comply with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.

2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
3. Provide seismic switch in accordance with ASME A17.1 and ASCE 7 requirements.

E. Perform welding of steel in accordance with AWS D1.1/D1.1M.

F. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.

G. Perform electrical work in accordance with NFPA 70.

H. Comply with fire protection sprinkler system of the hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction. Refer to Section 21 1300.

2.10 EMERGENCY POWER

A. Set-up elevator operation to run with building emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.

B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
1. Provide transfer switches and auxiliary contacts.
2. Install connections to power feeders.

C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.

D. Provide operational control circuitry for adapting the change from normal to emergency power.

E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that hoistway and pit are ready for work of this section.

C. Verify hoistway shaft and openings are of correct size and within tolerance.

D. Verify location and size of machine foundation and position of machine foundation bolts.

E. Verify that electrical power is available and of correct characteristics.

F. Notify Architect in writing of dimensional discrepancies or other conditions detrimental to proper installation or performance of elevators.

G. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer/installer.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components. Comply with requirements of Section 01 5000 - Temporary Facilities and Controls.

B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION

A. Install elevators in accordance with manufacturer/installer’s instructions and ANSI/ASME A17.1.

B. Set entrances in vertical alignment with car openings, and aligned with plumb hoistway lines.

C. Coordinate this work with installation of hoistway wall construction.

D. Install system components, and connect equipment to building utilities.

E. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 0533.13 and 26 2717.

F. Mount machines and motors on vibration and acoustic isolators.
1. Place on structural supports and bearing plates.
2. Securely fasten to building supports.

3. Prevent lateral displacement.

G. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.

H. Install guide rails to allow for expansion and contraction movement of guide rails.

I. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

J. Bolt or weld brackets directly to structural steel hoistway framing.

K. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime with two coats.

L. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

M. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime with two coats.

N. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

O. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.

B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.
   1. Schedule tests with agencies and notify Owner and Architect.
   2. Obtain permits as required to perform tests.
   3. Document regulatory agency tests and inspections in accordance with requirements.
   4. Perform tests required by regulatory agencies.
   5. Furnish test and approval certificates issued by authorities having jurisdiction.

C. Perform testing and inspection in accordance with requirements.
   1. Perform tests in accordance with ASME A17.2.
   2. Provide at least two weeks written notice of date and time of tests and inspections.
   3. Supply instruments and execute specific tests.

3.06 ADJUSTING

A. A. Adjust elevators for proper operation in accordance with manufacturer/installer’s instructions.

B. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

C. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

D. C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is in leveling zone and stopping at that landing.

E. E. Repair minor damages to finish in accordance with manufacturer/installer’s instructions and as approved by Architect.

F. F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.07 CLEANING

A. Remove protective coverings from finished surfaces.

B. Clean surfaces and components in accordance with manufacturers written instructions.

C. B. Do not use harsh cleaning materials or methods that could damage finish.

3.08 PROTECTION

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch-up, repair, or replace damaged products and materials before Date of Substantial Completion.

END OF SECTION

SECTION 21 1313

WET PIPE FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
1. Wet pipe sprinkler systems
2. Underground fire service mains
3. System design, installation, testing, and certification

B. Work not covered by this Section:
1. Installation of portable fire extinguishers
2. The wiring and monitoring of alarm switches and supervisory signaling system - (To be coordinated with the General Contractor)
3. All electrical installations - (To be coordinated with the General Contractor)
4. Fire pumps
5. Pump room, including all electrical, lighting, plumbing, heating/ventilation and other structural or environmental requirements - (To be coordinated with the General Contractor)
6. Pump pads – (To be coordinated with the General Contractor)

1.2 RELATED SECTIONS

A. Section 21 3116 Diesel Drive, Centrifugal Fire Pump

B. Section 21 4123 Ground Suction Storage Tank for Fire Suppression Water

C. Section 28 3111 Intelligent, Addressable Fire Alarm System

D. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

E. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed and/or FM Global (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the private underground fire service mains and/or fire sprinkler system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner’s minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code (“NCBC”)
   2. 2018 North Carolina Fire Code (“NCFC”)

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2013) – Standard for the Installation of Sprinkler Systems
   2. NFPA 20 (2013) – Standard for the Installation of Stationary Pumps for Fire Protection
   3. NFPA 24 (2013) – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
   4. NFPA 70® (2014) – National Electrical Code®
   5. NFPA 72® (2013) – National Fire Alarm and Signaling Code ®
   6. NFPA 1963 (2014) – Standard for Fire Hose Connections

C. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
   1. FM Global Research Approval Guide (most current edition including supplements)

E. American National Standards Institute (ANSI)
   1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose
   2. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
   3. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300
   4. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250
   5. ANSI/ASME B16.5 - Steel Pipe Flanges and Flanged Fittings
   6. ANSI/ASME B16.9 - Factory-made Wrought Steel Buttweld Fittings
   7. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welded and Threaded
   8. ANSI/ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
   9. ANSI/ASME B16.25 - Buttwelded Ends for Pipe, Valves, Flanges, and Fittings
   10. ANSI/ASME B36.10M - Wrought Steel Pipe

F. American Society for Testing and Materials (ASTM)
   1. ASTM A53 - Welded and Seamless Steel Pipe
   2. ASTM A126 - Gray Iron Castings for Valves, Flanges, Pipe Fittings
   3. ASTM A135 - Electric-Resistance-Welded Steel Pipe
   4. ASTM A183 - Carbon Steel Track Bolts and Nuts
   5. ASTM A193 - Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service

6. ASTM A194 - Carbon and Alloy Steel Nuts and Bolts for High Pressure and High-Temperature Service
7. ASTM A197 - Cupola Malleable Iron
8. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
9. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
10. ASTM F436 - Hardened Steel Washers
11. ASTM A536 - Ductile Iron Castings

G. American Welding Society (AWS)
1. WS D10.9 - Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

H. American Water Works Association (AWWA)
1. AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
2. AWWA C110 - Ductile Iron and Gray Iron Fittings, 3 in. through 48 in., for Water and Other Liquids
3. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
4. AWWA C115 - Flanged Ductile Iron Pipe and Threaded Flanges
5. AWWA C150 - Thickness Design of Ductile Iron Pipe
6. AWWA C151 - Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
7. AWWA C153 - Ductile Iron Compact Fittings, 3 in. through 12 in., for Water and Other Liquids
8. AWWA C502 - Dry-Barrel Fire Hydrants
9. AWWA C509 - Resilient-Seated Gate Valves for Water and Sewerage Systems
10. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances
11. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
12. AWWA C900-16 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 60 in., for Water

1.7 SYSTEM DESCRIPTION

A. Underground Fire Service Mains
1. Fire service water mains shall be provided and installed as indicated on the fire protection drawings and civil utility drawings and in accordance with this specification and Division 33. Where a conflict may exist between the civil and fire protection plans, the contractor shall submit a Request for Information (RFI) to both the civil and fire protection engineer’s attention for resolution.
2. Maximum working pressure for underground fire service mains upstream of any fire pump shall be in accordance with NFPA 24 (i.e., not less than 150 psi). Maximum working pressure for underground fire service mains downstream of any fire pump shall be not less than 175 psi.
3. Where underground mains pass through building walls, or require a vertical rise or drop, the pipe shall be cement-lined ductile iron (DIP) unless specifically noted otherwise. All fire water lead-ins (i.e., fire pump suction and discharge, and fire sprinkler) from 1 foot above the finished floor to 5 feet outside the exterior wall shall be cement-lined DIP. All other piping shall be as specified by the civil engineer on civil utility drawings and Division 33 specifications.
4. Fire hydrants shall be provided and installed as indicated on the fire protection drawings and civil utility drawings. The connection of each private hydrant to the fire main shall have a nominal diameter of 6 in. and shall include an underground gate valve equipped with a grade box provided not more than 3 ft from the hydrant it serves. Hydrant control valve is permitted to shift slightly (i.e., 1-3 ft) in order to avoid other aboveground items, such as curbs.

5. The top of all underground fire service mains shall have a minimum depth of cover below earth grade as required by local building codes, or NFPA 24, whichever is greater.
6. Underground mains upstream of the fire pump(s) shall be mechanically restrained against movement at all pipe joints, including all changes in direction, behind tees, hydrants, dead end lines or capped tees, and pipe-to-pipe joints. Alternatively, minimum required pipe lengths shall be mechanically restrained at all changes in direction (as noted) or thrust blocks used if, and only if, calculations are provided proving the minimum restrained length or minimum bearing area of thrust blocks. Mechanical joint restraints and/or thrust blocks provided upstream of the fire pump(s) shall be designed in accordance with NFPA 24 based upon a working pressure of 150 psi and the soil resistance (i.e., horizontal bearing strength) as determined by the geotechnical/ soils engineer, using a minimum safety factor of 1.5.
7. Underground mains downstream of the fire pump(s) shall be mechanically restrained against movement at all pipe joints, including all changes in direction, behind tees, hydrants, dead end lines or capped tees, and pipe-to-pipe joints. Alternatively, minimum required pipe lengths shall be mechanically restrained at all changes in direction (as noted) or thrust blocks used if, and only if, calculations are provided proving the minimum restrained length or minimum bearing area of thrust blocks. Mechanical joint restraints and/or thrust blocks shall be designed in accordance with NFPA 24 based upon a working pressure of 175 psi and the soil resistance (i.e., horizontal bearing strength) as determined by the geotechnical/ soils engineer, using a minimum safety factor of 1.5.
8. All fire water lead-ins into aboveground structures shall be provided with both mechanical joint restraints and concrete thrust blocks. Each thrust restraint method shall be individually provided in accordance with NFPA 24 as if it were the only restraint method being utilized for the fire water lead-in.
9. All rods, nuts, bolts and washers shall be coated with an acceptable corrosion-retarding material. Corrosion protection shall meet the requirements of NFPA 24.
10. Guard posts shall be provided around all aboveground fire sprinkler system components subject to vehicular damage, including, but not limited to, on-site hydrants, post indicator valves, and freestanding fire department connections. The posts shall be a minimum of 5-in. Schedule 40 pipe filled with concrete. The top of each post shall be 4 ft. above grade level and shall extend a minimum of 3 ft. below grade. Posts shall be anchored in concrete. A minimum clear space of 3 ft. shall be maintained between each post and the component being protected.
11. The underground fire service mains shall be provided with sectional valves to sectionalize the fire service main loop around the building. Sectional valves shall be provided in accordance with the fire protection drawings. The design intent is to ensure a given section of underground fire service main has no more than six (6) connections. A connection is considered a sprinkler system, hydrant, fire department connection (FDC), and/or standpipe (as may be applicable).

B. Sprinkler Systems

1. Sprinkler system designs for the facility shall be in accordance with the Sprinkler Design Schedule on the fire protection drawings.
2. Sprinkler system zones protecting the warehouse area shall not exceed 40,000 sq. ft.
3. Sprinkler system piping within the warehouse area, with the sole exception of sprinkler system risers, shall be installed so that no part of any feed mains, cross mains, or branch lines is located lower than the minimum clear height specified by the Architect and as indicated on the contract documents.
4. Each system riser shall be equipped with an indicating control valve, riser check valve, waterflow switch, pressure gauges (one each installed above and below the clapper of the riser check valve), main drain, and inspector’s test connection.
5. Each riser manifold shall include a minimum 8-in. grooved end cap to facilitate the flushing of the underground lead-ins.

C. Hydraulic Design Requirements

1. Sprinkler Discharge Area: The size, shape, and location of the discharge area for each system shall be as defined in NFPA 13.
2. The hydraulic design of sprinkler systems (if applicable) shall consider two additional flowing sprinklers to account for additional sprinklers installed beneath current or future conveyors or other obstructions. Where obstructions are known (e.g., make-up air units, current conveyors, etc.), the flow for the additional sprinklers shall be applied as designed; where the obstructions are not known, the flow for two additional sprinklers shall be applied at the remote end of the near cross main. In all cases, each system must be proved for both known and unknown obstruction conditions, as conditions dictate.
3. Friction Losses: Losses in pipe shall be calculated in accordance with the Hazen-Williams formula with "C" values in accordance with NFPA 13.
4. Hose Stream Allowances: Include an allowance for hose streams as required by NFPA 13 and as indicated on the Sprinkler Design Schedule. Inside hose stream allowances shall be taken at the base of the riser. Outside hose stream allowances shall be taken at the nearest hydrant.
5. The water supply to be utilized for hydraulic calculation purposes shall be as indicated on the fire protection drawings. However, the contractor shall be responsible to conduct a new flow test in order to ensure that the most recent and applicable water supply data is used for hydraulic calculation purposes. Flow tests conducted by the contractor shall be performed with input from the Engineer. In addition, adjustments to the flow test data shall be in accordance with the Engineer's direction.
6. The effective point for the water supply shall be as indicated on the fire protection drawings. The Engineer shall be consulted to confirm the effective point of any new water flow data obtained by the contractor, in accordance with the previous requirement.
7. A safety margin shall be provided for all hydraulically calculated systems. The safety margin between the system demand and the available water supply shall be provided at the fire pump discharge flange of the worst-case water supply (i.e., the fire pump taking suction from the onsite water storage tank or the fire pump taking suction from the public water utility). The available water supply to the pump taking suction from the onsite water storage tank shall be based upon an empty tank (i.e., do not account for the static head the column of water in the tank would provide) and the minimum safety margin to all system demands shall not be less than 5 psi. The available water supply to the fire pump taking suction from the public water utility shall be as indicated on the fire protection drawings and the minimum safety margin to all system demands shall not be less than 10 psi.

D. Location of Sprinklers

Location of sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13, the listing of each sprinkler, and the fire protection drawings. The spacing of sprinklers on the branch lines for open areas shall be essentially uniform.

E. Alarm and Supervisory Devices

1. Provide and install the following alarm and supervisory switches that shall be connected to the building Fire Alarm Control Unit (FACU) by the fire alarm contractor.
   a. Tamper Switches: All valves directly controlling water to fire sprinklers, including the backflow prevention device, shall be provided with tamper supervisory devices. An off-normal signal shall be initiated during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position, whichever is less. Each tamper switch shall initiate a distinct supervisory indication. Underground key operated valves are exempt from this requirement.

b. Waterflow Switches: Each wet-pipe sprinkler system shall be provided with a vane-type waterflow device. Waterflow signals shall be priority signals that shall identify the flow device that is activated.

2. The fire sprinkler contractor shall provide no other fire alarm related components.

F. Drain pipes and valves shall be installed on each system to allow drainage. Each system shall drain to the maximum extent possible through the main drain valve. Discharge from drain pipes shall be to the building exterior, directed away from the building and stairs. The discharge from each drain pipe shall be piped to within 8 in. of grade. Concrete splash blocks under each drain outlet shall be provided where necessary to prevent soil erosion.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Drawings

1. Prepare and submit an electronic set (in PDF format) of detailed shop drawings indicating the proposed layout of equipment (including fire pump room, as applicable), fire service mains, risers, hangers, pipes and sprinklers. Shop drawings shall clearly indicate the locations and dimensions (to scale) of all potential obstructions or other interference to the sprinkler systems, including (but not limited to): bar joists, bottom chord bridging, x-bracing, lighting fixtures, ceiling fans, duct work, roof-top exhaust fans, HVLS fans, etc.
2. Prepare working drawings at a scale not less than 3/32 in. = 1 ft., on sheets not smaller than 24 in. x 36 in., in accordance with all requirements for "Working Drawings (Plans)" as specified in NFPA 13 and NFPA 24. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.
3. A complete set of one-half scale shop drawings shall be submitted to the Engineer upon final approval and prior to the Engineer’s first site review.
4. Provide an Alternate Price to include BIM LOD 300. The components should be detailed as follows:
   a. All spaces shall detail for each sprinkler riser, fire protection equipment, and piping that may impact access or clearances within each space.
   b. Items not to be included in the BIM requirement are sprinklers, branch lines, accessories, meters, gauges, seismic restraints, etc.

B. Product Data

Submit an electronic set of descriptive data (in PDF format) annotated to show the specific model, type, and size of each item proposed. Full descriptive data shall be submitted for all components essential to proper installation, including, but not limited to: sprinklers, pipe, fittings, gate valves, butterfly valves, check valves, hangers, flow switches, tamper switches, pumps, indicator posts, underground pipe, devices, materials and associated equipment. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.

C. Hydraulic Calculations

1. Prepare and submit an electronic set of hydraulic calculations in PDF format. A separate hydraulic calculation must be submitted for each sprinkler system. Nodes or reference points must be clearly identified on the shop drawings. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.
2. At a minimum, hydraulic calculations shall include the following: cover sheet, water supply data, aggregate flow data, node data including elevations, pressures, K-factors, and discharges, fittings table of equivalent lengths used in the calculation, node-to-node hydraulic calculation data, flow diagrams, and pressure/flow curves.

D. Submittals to the Authorities Having Jurisdiction

Submit shop drawings, product data, and hydraulic calculations directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities' field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

E. Project Record Documents

1. Sprinkler Contractor's Superintendent shall prepare, on a daily basis, redlined shop drawings to record as-built conditions. Submit completed redline drawings to the Engineer at project completion.
2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on electronic media (CD or DVD) in PDF and AutoCAD formats.

F. Operation and Maintenance Data

Furnish two (2) sets of instruction manuals containing complete operation and maintenance instructions for the specific make and model of all check valves, control valves, waterflow and pressure switches, valve supervisory switches and other components supplied. Include maintenance data relative to components of system, servicing requirements, inspection data, replacement part numbers and availability, and location and numbers of service depot.

G. Contractor's Material and Test Certificates

Upon completion of required testing, submit completed and signed Contractor's Material and Test Certificates, for aboveground and underground piping, certifying systems meet or exceed the specified requirements.

1.9 QUALITY ASSURANCE

A. Qualifications

1. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of sprinkler systems. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
2. Contractor shall be a firm specializing in performing work of this Section with a minimum of three years of experience and must be regularly engaged in making such installations.
3. Contractor shall have successfully installed automatic fire sprinkler systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The Contractor shall submit a copy of a valid state sprinkler contractor certificate and license, as applicable.
4. Contractor shall provide workers normally employed in the field and as otherwise specified in NFPA 13 and local ordinances.
5. All material shall be new and in good condition, free of defects, scratches, corrosion and contamination. Used equipment shall not be permitted.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-listed and/or FM-approved.

C. Regulatory Requirements

1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13 and NFPA 24, to other applicable NFPA standards, to all Local, State and Federal codes, and to all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, product data, and hydraulic calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal's office.
3. Deviations from the contract documents and the contractor's approved submittal documents will not be permitted without written consent from the Engineer.
4. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 13, Local, State, or Federal requirements, and the requirements of the Authorities Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place. Maintain in place until installation.

B. Provide temporary protective coating on cast iron and steel valves.

1.11 SEQUENCING

A. Flushing of the underground mains and lead-ins must be completed in accordance with the requirements of NFPA 20 and NFPA 24 and underground notes on the fire protection drawings before connection is made to aboveground sprinkler or fire pump piping.

1.12 GUARANTEE

A. The Contractor, in addition to other warranties or guarantees required by the contract documents, shall guarantee workmanship on all piping, devices, and related materials for a period of one year from the date of the Engineer's final acceptance of the work. All defects shall be promptly corrected at no cost to the Owner.

B. The Contractor is responsible for providing a system that has been coordinated with the contract documents and approved by all concerns referenced in this document including, but not limited to, the Owner, local authorities, and the Owner's representatives.

1.13 EXTRA MATERIALS

A. Provide spare sprinklers in accordance with the provisions of NFPA 13. The quantity of each type of extra sprinkler shall be as specified in NFPA 13, except that 24 spare warehouse area sprinklers shall be provided.

B. Provide manufacturer's sprinkler wrenches in each metal sprinkler cabinet for each type of sprinkler stored in the box.

C. Provide metal cabinets for storage of spare sprinklers and sprinkler wrenches. Cabinets shall be of sufficient size to permit spare sprinklers to fit upright and reasonably secured within the sockets of the cabinets; spare sprinklers shall not be laid on their sides within the cabinets. Cabinets shall be located within the fire pump room, unless otherwise indicated.

1.14 HYDRAULIC DESIGN INFORMATION SIGN

A. Provide a permanently marked, weatherproof metal or rigid plastic sign, with the following information inscribed thereon:
   1. Location of the design area or areas
   2. Discharge densities over the design area or areas, or number and discharge pressure of calculated sprinklers, as applicable
   3. Required flow and residual pressure demand at the base of the riser
   4. Occupancy classification or commodity classification and maximum permitted storage height and configuration
   5. Hose stream demand included in addition to the sprinkler demand

B. The lettering on the sign shall be engraved or otherwise typeset. Handwritten signs shall not be accepted.

C. Signs shall be permanently secured to the system riser with corrosion resistant wire, chain, or other approved means.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment supplied under this specification shall be new and shall be UL-listed and/or FM-approved for fire protection service and installed and used as intended by the listing.

2.2 UNDERGROUND FIRE SERVICE MAINS

A. Underground pipe shall be UL-listed or FM-approved for fire protection service and shall be ductile iron pipe meeting AWWA C150 and AWWA C151, cement-mortar lined in accordance with AWWA C104, and laid in accordance with AWWA C600, or PVC piping meeting C900 and laid in accordance with AWWA C605.

B. The pressure class of the pipe, joints, fittings, valves and hydrants shall not be less than the maximum working pressure of the system under non-emergency (no-flow) conditions, with the fire pump running. In no case shall the pressure class be less than 175 psi.

C. Ductile iron pipe shall be joined by mechanical or push-on joints meeting AWWA C111, cast iron flanges meeting ANSI B16.1, ductile iron flanges meeting AWWA C115, or other approved means.

D. Fittings shall be cast iron meeting ANSI B16.1 or ductile iron meeting AWWA C110.

E. Fire hydrants shall be dry-barrel, high-pressure type, meeting the requirements of the local jurisdiction.

F. Underground sectional valves shall be AWWA NRS gate valves equipped with the mounting flange for indicator posts.

2.3 ABOVEGROUND PIPING SYSTEMS

A. Sprinkler pipe shall be per NFPA 13 and shall be steel conforming to ASTM A-53, A-135, or A-795. Piping joined by welding or rolled-groove methods shall have a minimum nominal wall thickness in accordance with Schedule 10 for sizes less than 6 in. (150 mm), 0.134 in. (3.40 mm) for 6 in. (150 mm), and 0.188 in. (4.78 mm) for 8 and 10 in. (200 and 250 mm). Piping joined by threaded methods shall be Schedule 40 for sizes less than 8 in. (200 mm) and Schedule 30 for sizes 8 in. (200 mm) and larger. Wall thicknesses less than those described above may be used if the pipe is specifically listed for fire sprinkler service and carries a UL Corrosion Resistance Ratio of at least 1.0, including when joined.

B. Pipe shall be joined by threaded, rolled groove, welded or flanged methods. Welding methods shall comply with all requirements of AWS D10.9, threads shall be cut to ANSI/ASME B 1.20.1, and groove dimensions shall be compatible with the listings of the couplings and fittings used. Flange gaskets shall be red rubber sheet, 1/16 in. thick, conforming to ASTM D-2000. Gaskets for grooved couplings shall be EPDM, grade E type A, conforming to ASTM D-2000.

C. Grooved couplings and fittings shall be of the same manufacturer.

D. Fittings shall be cast iron conforming to ANSI B16.1 or ANSI B16.4, malleable iron conforming to ANSI B16.3, or steel conforming to ANSI B16.5, ANSI B16.9, ANSI B16.11, ANSI B16.25, or ASTM A234.

E. Where changes in pipe diameters occur or are required, only tapered fittings (e.g., reducing tees, concentric reducers) shall be used. Reducing couplings shall not be utilized.

2.4 SPRINKLERS

A. Sprinkler selection for each hazard area shall be in accordance with the Sprinkler Design Schedule indicated on the fire protection drawings.

B. Upright and pendent sprinklers in unfinished areas shall have natural brass finish.

C. Pendent sprinklers in all finished areas shall be recessed or semi-recessed type with a chrome finish, unless otherwise noted on the drawings.

2.5 PIPING SPECIALTIES

A. Wet-pipe Sprinkler Riser Valve: Provide Viking Easy Riser Swing Check Valve or equivalent, equipped with 2-in. main drain valve piped to exterior, and inlet and outlet pressure gauges for each individual sprinkler system.

B. Pressure Relief Valve: Each wet-pipe sprinkler system shall be provided with a listed pressure relief valve not less than ½ in. in size and set to 10 psi above working pressure of the system (i.e., 185 psi). Relief valve shall be the Globe Model ARV Adjustable Relief Valve (GFV-575), or equivalent.

C. Waterflow Indicators: Provide vane-type waterflow switches at each individual wet-pipe sprinkler system supply. Switch shall have sensitivity setting to signal any flow of water that equals or exceeds the discharge from the smallest sprinkler installed on the system. Waterflow switch mechanisms shall incorporate an instantly recycling, adjustable retard element, adjustable up to 90 seconds, which shall be set between 30 and 60 seconds. Switches shall be rated at 175 psi cold water pressure. Switches shall be compatible with the fire alarm system and NFPA 72.

D. Valve Supervisory Switches: Provide fire sprinkler control valves with approved supervisory (tamper) switches. The switch shall be designed to transmit a supervisory signal to the building fire alarm system. The supervisory signal shall be obtained during the first two revolutions of the hand wheel or operating crank. The switch shall not interfere with the operation of the valve, nor obstruct the view of its indicator. The trouble signal shall be obtained during abnormal interconnecting circuit conditions. Devices shall be compatible with the fire alarm system and the requirements of NFPA 72. All switches shall be suitable for installation of end-of-line devices. Switch shall incorporate tamper-resistant features.

1. Valves that are normally closed must be provided with valve supervisory switches that properly monitor the valve in the closed positions.

E. Pressure Gauges: Pressure gauges shall be the Bourdon-tube type with a metal corrosion-resistant case, flat glass window, 3½-in. diameter white background dial with black markings, and a 0-300 psig range. Gauge accuracy shall be 3-2-3% of full range. A shutoff valve shall be provided with each gauge connection.

2.6 VALVES

A. Provide valves as required by NFPA 13 and of types approved for fire protection system service. Valves 2 in. and smaller shall be bronze. Unless otherwise specified, valves 2½ in. and larger shall be bronze mounted with iron bodies.

B. Gate Valves
1. Up to and including 2 in.: Bronze body, bronze trim, rising stem, handwheel, inside screw, single wedge or disc.
2. Over 2 in.: Iron body, bronze trim, rising stem, handwheel, OS&Y (unless provided with an indicator post), single wedge, resilient-seated.

C. Globe Valves
1. Up to 2 in.: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, with backseating capacity repackable under pressure.
2. Over 2 in.: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, renewable seat and disc.

D. Ball Valves
1. Up to and including 2 in.: Bronze one-piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops.
2. Over 2 in.: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged.

E. Butterfly Valves
1. Bronze body, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch compatible with the fire alarm system.
2. Cast or ductile iron body, chrome plated ductile iron disc, resilient replaceable EPDM seat, extended neck, handwheel and gear drive and integral indicating device and built-in tamper proof switch compatible with the fire alarm system.

F. Fire Department Hose Valves
1. Brass body, UL-listed/ FM-approved
2. Field adjustable pressure restricting mechanism, rated inlet pressure to 200 psi.

2.7 PIPE HANGERS

A. Pipe hangers, braces and supports shall be provided in accordance with NFPA 13.

B. Hangers for support of piping and equipment shall be UL-listed and/or FM-approved for fire protection service. Supports, including all-thread rods, shall not interfere with access to operating areas or contact building services equipment.

2.8 PIPE SLEEVES

A. For sleeves in masonry concrete walls, floors, roofs provide ASTM A53, Schedule 40 or standard weight, hot-dip galvanized steel pipe sleeves.

B. For sleeves in partitions, and other than masonry and concrete walls, floors and roofs provide hot-dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per sq. ft.

2.9 PIPE ESCUTCHEON PLATES

A. Provide approved one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed areas. Provide chromium-painted finish on plates in finished areas. Securely anchor plates in place with set screws or other approved means.

2.10 FIRE DEPARTMENT CONNECTION

A. Provide an approved fire department connection in accordance with the fire protection drawings and local requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate the work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment and shall take any necessary measures to keep the premises dry at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Prior to the operation (opening or closing) of any valve controlling water to the domestic or fire system, notification shall be given to, and approval obtained from, the General Contractor.

D. The A/E, Developer and Owner shall NOT be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. The responsibility rests with the Contractor.

E. Ream pipe and tube ends. Remove burrs and fins.

F. Prepare piping connections to equipment with flanges or unions.

G. All excess oil, dirt, pipe joint compound, rust, mill scale, and factory coatings shall be removed from piping and equipment. All dirt, debris and excess cutting oil shall be removed from the interior of all piping and equipment before it is erected.

3.2 INSTALLATION

A. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean. All piping in areas with finished ceilings shall be concealed. All wiring shall be in metal conduit.

B. Inspect, test, and approve piping before covering, or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in pipe sizes through tapered reducing pipe fittings; the use of bushings will not be permitted. Welding shall be performed in the shop; field welding will not be permitted. Conceal piping, fittings, fixtures, hangers and supports in areas with suspended ceilings and finished areas.

C. Install equipment in accordance with manufacturer’s instructions.

D. Use proper lubricant on ends of piping or gaskets where required by pipe fitting or coupling manufacturer. The manufacturer’s recommended lubricant shall be used.

E. Where required by manufacturer, properly torque bolts to manufacturer’s specifications using a torque wrench.

F. All sprinklers shall be installed after the piping has been installed at ceiling level, and not while the piping is on ground level. There shall be no exceptions.

G. Place pipe runs to minimize obstruction to other work.

H. Insulate connection between pipe and fittings, hangers or dissimilar metal against direct contact. Use dielectric insulating flanges and units.

I. Support all sprinkler piping, standpipe risers, etc., as specified in applicable NFPA standards.

J. Provide a grooved end cap fitting at ends of all cross mains and riser manifolds to serve as flushing connections.

K. The Contractor shall install equipment, piping and hangers so that it will not interfere with piping, lighting, electrical conduit and wiring, structural members, air-conditioning equipment, and ceiling construction. If any such interference exists or occurs, the Contractor shall make the necessary adjustment to permit satisfactory installation of the equipment with no additional cost.

L. Sprinkler installation shall be coordinated with the installed mechanical and electrical work and the ceiling grid/layout. Where sprinklers are to be installed on modular ceiling panels (lay-in acoustical tile), sprinklers shall be located in the center of the ceiling panel or located in other symmetrical pattern acceptable to the Building Owner's Representative and in accordance with referenced standards and design drawings. The Contractor shall furnish additional sprinklers that may be required for coordinated ceiling pattern without additional cost to the Owner, even though number of sprinklers may exceed minimum code requirements.

M. The Contractor shall install the piping and equipment in accordance with approved shop drawings.

N. Main and Auxiliary Drains
   1. Each system shall be furnished with a main drain that is capable of draining the majority of the system. Drains shall discharge to the exterior. Drainage to floor is not permitted.
   2. Auxiliary drains shall be provided to drain any sections of piping that trap water, or are not capable of being drained by the main drain in accordance with NFPA 13. Auxiliary drains shall discharge to the exterior to the maximum extent possible and the location shall be approved by the Architect or Engineer.
   3. All drains terminating outside shall be piped to within 8 in. of finished grade. Concrete splash blocks shall be provided at grade level beneath all outside drains to preclude soil erosion where necessary.

O. Install piping to conserve building space, and not interfere with use of space and other work.

P. Group piping whenever practical at common elevations, as permitted by the structural design and the sprinkler layout, without creating obstruction conflicts with sprinklers.

Q. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

R. Coordinate location and method of hanging of sprinkler piping 4 in. and larger with the structural design; provide additional structural bracing where necessary. Do not penetrate structural members without the prior written approval of the structural engineer.

S. Tapping or drilling of load-bearing structural members is not permitted. Attachments may be made to steel or concrete structures with approved clamps and hangers designed in accordance with NFPA 13 and local standards.

T. Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Grout sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide

sleeves in non-seismic areas that are nominally 2 in. larger in diameter compared to the nominal size of the primary pipe penetration the wall, floor, roof, or partition. Comply with NFPA 13 clearance requirements in seismic areas. Firmly pack space with noncombustible insulation and caulk at both ends of the sleeve with plastic waterproof cement that will dry to a firm but pliable mass, or provide a segmented elastomeric seal. In fire-resistive rated assemblies (walls, floors, ceiling and partitions), pack space with approved firestopping materials. Installation of materials shall result in fire resistance rating equal to or greater than the assembly rating, unless otherwise indicated. Extend sleeves in floor slabs 3 in. above the finished floor.

U. Die cut screw joints with full cut standard taper pipe threads with non-toxic joint compound applied to male threads only.

V. Install valves with stems upright or horizontal as required, not inverted. Remove protective coatings after installation.

W. The Contractor is responsible for coordination of system requirements with all conditions of the building and site including, but not limited to, blind spaces, shelving, lights, grilles and diffusers, piping, duct work, doors, windows, equipment platforms, walls (fire-rated and non-fire-rated), beams, joists, columns, HVAC equipment, electrical panels and equipment, ceilings, areas without ceilings, wall construction, floors and all construction, equipment and building appurtenances. Contractor shall coordinate the layout of equipment, piping and materials to be located within the Pump Room with the General Contractor to assure sufficient space and openings to accommodate the entire installation, and accessibility for maintenance and replacements, if necessary.

X. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

Y. Provisions shall be made by the Contractor to protect piping, sprinklers and other components of the sprinkler systems from exposure to the elements or extreme climatic conditions including freezing and high temperature.

Z. Pipe Hangers:
   1. In areas subject to water pressures in excess of 100 psi, provide a hanger, designed to prevent upward pipe movement, within 12 in. of a pendent sprinkler located at the end of a branch-line or on armovers over 12 in. in length in areas with suspended ceilings. All-thread rods longer than 20 ft. supporting armovers or end sprinklers require additional reinforcement to prevent buckling.
   2. Hangers shall be positioned such that they are connected to pipe segments only and not to fittings.

AA. Identification signs shall be provided. Attach properly lettered approved metal signs conforming to NFPA 13 to each valve and alarm device. Permanently affix hydraulic design data nameplates to the riser of each system. Provide signs on the sprinkler control valve of each system. The sign shall identify the area of coverage controlled by the valve.

BB. Provide an inspector’s test connection (ITC) for each sprinkler system and locate the ITC on the exterior wall and connected to the sprinkler system riser. All ITC locations shall be approved by the Architect or Engineer. Each ITC terminating outside shall be piped to within 8 in. of finished grade. Concrete splash blocks shall be provided at grade level beneath each discharge to preclude soil erosion where necessary.

CC. Thrust Blocks
1. The trench in the area of each fitting shall be cut to provide a thrust block bearing surface on undisturbed soil.
2. Concrete shall be poured using forms to fit snugly against as much of the fitting as possible without interfering with access to fitting joints.
3. The concrete shall be allowed a minimum curing time of five days.

3.3 SPRINKLERS (PENDENT TYPE)

A. The sprinkler contractor shall be responsible for proper consideration of all obstructions and other installed equipment which may have an impact on the operation of sprinklers.

B. Prior to the start of construction, the sprinkler contractor shall closely coordinate with all other trades, including, but not limited to, structural steel, mechanical, electrical, plumbing, data processing, and material handling to ensure the water discharge from sprinklers will not be prohibited from reaching burning commodities at high volume and high momentum.

C. The standard to be utilized in identifying sprinkler placement and obstruction issues shall be the latest version of NFPA 13 and the Fire Protection Criteria Drawings. Any obstruction issue identified during the course of construction or acceptance inspections shall be corrected to meet the requirements of this standard at no additional cost.

D. Sprinklers shall be located such that vertical supply ducts from unit heaters are centered between 4 sprinklers. If vertical duct is not centered, or if the diffuser component measures larger than 48 in. by 48 in., an additional sprinkler shall be located below the diffuser component. The flow and pressure demand from that additional sprinkler shall be added to the hydraulic demand of the sprinkler system. Where the bottom of the diffuser is not a horizontal plane capable of banking the heat from a fire to the sprinkler, a horizontal barrier that extends to all edges of the diffuser shall be provided and installed above the sprinkler.

E. The contractor shall space sprinklers with consideration of the location of all skylights and/or roof vents so that a sprinkler is not located directly underneath a skylight or roof vent. Refer to architectural drawings for the locations of skylights and roof vents, as applicable.

3.4 INSPECTIONS AND TESTING

A. The system shall be subject to inspection and acceptance by the Engineer and the Authorities Having Jurisdiction for the purpose of determining the system is in accordance with federal, state, local and specification requirements, applicable standards of the NFPA, and other related codes or standards.

B. The Contractor shall be responsible for performing and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification.

C. Inspection and test procedures shall be submitted to the Engineer for approval prior to use.

D. All underground piping shall be completely flushed in accordance with NFPA 20 and NFPA 24 in the presence of the Engineer. Flushing procedures are subject to the approval of the Engineer and the Authorities Having Jurisdiction.

E. All underground piping shall be hydrostatically tested at not less than 200 psi or 50 psi above working pressure (i.e., 225 psi) for 2 hours in accordance with NFPA 24 and as indicated on the fire protection drawings. Before testing, the trench shall be backfilled between joints in accordance with NFPA 24. All joints shall be left exposed during the test.

F. Each hydrant shall be fully opened and closed under full system pressure with the fire pump running and checked for proper drainage.

G. All interior system piping shall be hydrostatically tested at not less than 225 psi for 2 hours in accordance with NFPA 13.

H. All operating parts, including electrical equipment, shall be fully tested to ensure their proper operation. All control valves shall be fully closed and opened under full system pressure, with the fire pump running.

I. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified two weeks in advance of the tests in order to arrange attendance at the tests.

J. The Contractor shall perform supplemental tests and shall render additional services in connection with the sprinkler system, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

~END OF SECTION~

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SECTION 21 1317

PREACTION FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
   1. Preaction sprinkler system
   2. System design, installation, and certification

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 21 3116 Diesel Drive, Centrifugal Fire Pump

C. Section 21 4123 Ground Suction Water Storage Tank for Fire Protection

D. Section 28 3111 Intelligent, Addressable Fire Alarm System

E. Unless specifically modified by this section, the requirements of Section 21 1313 shall apply to the design, material/ equipment, installation, and testing of the preaction sprinkler system.

F. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

G. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed and/or FM Global (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the private underground fire service mains and/or fire sprinkler system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner’s minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the

local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code ("NCBC")
   2. 2018 North Carolina Fire Code ("NCFC")

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2013) – Standard for the Installation of Sprinkler Systems
   2. NFPA 20 (2013) – Standard for the Installation of Stationary Pumps for Fire Protection
   3. NFPA 24 (2013) – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
   4. NFPA 70® (2014) – National Electrical Code®
   5. NFPA 72® (2013) – National Fire Alarm and Signaling Code®
   6. NFPA 1963 (2014) – Standard for Fire Hose Connections

C. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
   1. FM Global Research Approval Guide (most current edition including supplements)

1.7 SYSTEM DESCRIPTION

A. Preaction Sprinkler Systems
   1. Provide a double interlock preaction fire sprinkler system to protect the MDF Room. The system shall be arranged with independent electric and pneumatic (fully mechanical) interlocks such that water will not be admitted into the system piping unless both the electronic detection system is activated AND supervisory air pressure is lost in the system piping.
   2. Double interlock preaction sprinkler system shall be designed and installed in accordance with the requirements of NFPA 13, the fire protection drawings, and this section.
      a. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping, and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.
   3. Preaction sprinkler system riser and all trim components shall be located as indicated on the drawings.

B. Control System

1. Control of the double interlock preaction sprinkler system shall be by a UL-Listed Intelligent/Addressable Releasing Service Fire Alarm Control Unit (RSFACU), as specified in Section 28 3111.
2. The control system shall meet the requirements of NFPA 72. The control panel and the solenoid valve that activates the water control valves shall be compatible with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.
3. The detection system shall consist of spot-type photoelectric smoke detectors installed in the room and air-sampling smoke detection (ASSD) installed in the space above the room and below the structural steel above. Alternatively, all smoke detection for the MDF Room and the concealed space above the MDF Room ceiling may be protected by air-sampling smoke detection. The layout and spacing shall be in accordance with NFPA 72, equipment and manufacturer's instructions with respect to ceiling height and quantity of airflow in the protected areas.
4. Selection of cable types and wire with respect to conductor size, shielding requirements, and separation between circuits shall be in full compliance with the requirements of the manufacturer of the RSFACU, without exception. All circuit wire/cable shall be specifically listed for use with fire alarm systems.
5. Power Supply: The primary operating power shall be in accordance with NFPA 72. Transfer from normal to backup power and restoration from backup to normal power shall be fully automatic and shall not initiate a false alarm. Loss of primary power shall not prevent actuation of the respective automatic water control valve upon activation of any alarm initiating device. Backup power shall be provided through use of rechargeable, sealed, lead acid storage batteries.
6. The RSFACU shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
7. All subpanels, such as power expanders, shall be designed for future expansion and modification. In no case shall circuit and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.

C. System Operational Features
1. The system shall include an automatic fire detection system, manual actuation station, supervisory and alarm switches, and associated equipment. Preaction sprinkler system piping shall be provided with supervisory air pressure not to exceed 40 psig.
2. System Actuation: Activation of any detection device in the MDF Room shall actuate alarm zone circuits of the control panel and activation of a second device in the MDF Room shall release the electronic interlocks on the corresponding automatic water control valve covering the corresponding sprinkler system.
3. Activation of any detection device or manual actuation station shall cause an alarm signal to be received at the building Fire Alarm Control Unit (FACU).
4. Activation of any sprinkler waterflow pressure-type alarm switch shall cause an alarm condition at the building FACU.
5. Valve tamper and supervisory air pressure signals shall be monitored by the building FACU as supervisory conditions.

D. Location of Sprinklers
1. Location of sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 and the listing of each sprinkler. The spacing of sprinklers on the branch line(s) for open areas shall be essentially uniform.

E. Alarm and Supervisory Devices
1. Provide and install the following alarm and supervisory switches that shall be connected to the FACU by the contractor.

a. Tamper Switches: All valves directly controlling water to fire sprinklers shall be provided with tamper supervisory devices. Refer to fire protection drawings.
b. Waterflow Switches: The preaction sprinkler system shall be provided with a pressure-type waterflow device compatible with the fire alarm system and NFPA 72. Waterflow signals shall be priority signals that shall identify the flow device that is activated.
c. Air Pressure Supervisory Switches: The preaction system shall be provided with a device to monitor the air pressure within the system piping. The device shall initiate a supervisory signal for high and low-pressure conditions.
d. Preaction valve release solenoid: Each preaction valve trim shall be provided with a device to release the electronic portion of the double interlock in accordance with the manufacturer's requirements.

F. Drain pipe and valve shall be installed on the system to allow drainage. The system shall drain to the maximum extent possible through the main drain valve.

G. Preaction System Operating Sequence
1. When the initial detector of the detection system in the MDF Room activates, the RSFACU initiates an alarm signal to the FACU.
2. When the second detector of the detection system in the MDF Room activates, the FACU releases the first (electronic) interlock on the deluge (preaction) valve.
3. Simultaneously, a set of contacts provided as an input for the EPO system changes state.
4. When a sprinkler is opened by heat from a fire, air flows out of the open sprinkler, lowering the air pressure in the system. The drop in air pressure causes the release of the second (pneumatic) interlock on the deluge valve.
5. Once both interlocks are released, the deluge valve opens and water flows in the sprinkler piping to the open sprinkler.
6. A waterflow signal shall be generated for transmission via the RSFACU to the FACU upon waterflow in each system equal to or greater than any one sprinkler.
7. Valve tamper switch activation shall be monitored by the FACU via the RSFACU.
8. The RSFACU shall generate a supervisory signal at the FACU when the air pressure in the preaction system distribution piping exceeds or falls below the maximum and minimum allowable air pressures respectively.

H. Work Not Covered by this Section
1. Electrical circuit (110 VAC/ 60 hz) for the air compressor

PART 2 - PRODUCTS

2.1 ABOVEGROUND PIPING SYSTEMS

A. Sprinkler pipe shall be internally galvanized and per NFPA 13 and shall be steel conforming to ASTM A-53, A-135, or A-795. Piping joined by welding or rolled-groove methods shall have a minimum nominal wall thickness in accordance with Schedule 40 for sizes 8 in. (200 mm) and less. Piping joined by threaded methods shall be Schedule 40 for sizes less than 8 in. (200 mm) and Schedule 30 for sizes 8 in. (200 mm) and larger.

2.2 SPRINKLERS

A. Sprinkler selection for the hazard area shall be 5.6 K-factor, ordinary-temperature rated, quick-response, dry pendent type with white concealed escutcheons.

2.3 PREACTION SYSTEM RISER

A. The preaction double interlock system riser shall field-assembled; the preaction valve itself (i.e., the valve and necessary associated trim) shall be factory-assembled.
   1. Detection and release shall be provided by a Releasing Service Fire Alarm Control Unit (RSFACU).
   2. Supervisory air shall be provided via a riser mounted air compressor.
   3. The detection shall be single zone.
   4. The system shall utilize an electric and a pneumatic interlock.

B. Automatic Water Control Valve (Deluge Valve): Automatic water control valve (deluge valve) shall be electrically-actuated and rated for a working pressure of 175 psi. Valve shall be capable of being reset without opening the valve. Valve shall be of the type that does not require priming water to be properly set.
   1. Electrical solenoid valve used to actuate the water control valve shall be an integral component of the valve or shall be approved for use by the water control valve manufacturer. Solenoid valve shall be rated at 24 volts direct current and shall be normally closed type that operates when energized. Solenoid valves shall be rated for a maximum pressure differential of 175 psi.
   2. Water control valve shall be equipped with a means to prevent the valve from returning to the closed position until being manually reset.
   3. Assembly shall be factory-assembled with the valve manufacturer's standard trim piping for double interlock preaction systems, drain and test valves, pressure gauges, and other required appurtenances.
   4. Each assembly shall include an emergency release device for manually tripping the water control valve in the event of a power or other system failure. Device shall be a standard accessory component of the valve manufacturer and shall be labeled as to its function and method of operation.
   5. Automatic water control valves shall the following or approved equivalent:
      a. Viking Model E-1 Deluge Valve with double interlock (electric/pneumatic) releasing trim

C. Riser Check Valve: Provide riser swing check valve equipped with main drain valve piped to the building exterior, to within 8 inches of grade, and inlet and outlet pressure gauges for each individual sprinkler system.

D. Isolation, Indicating Control Valve: Provide an indicating control valve above the preaction and check valves to isolate the system riser from the system piping.

E. Air Pressure Supervisory Switch: Low air pressure switch shall detect a 10 psi off normal system air pressure. The switch shall be capable of being mounted in any position in the alarm line trim piping of the preaction valve trim.

F. Valve Supervisory Switches: Provide sprinkler control valves with approved supervisory (tamper) switches. The switch shall be designed to transmit a supervisory signal to the building fire alarm system. The supervisory signal shall be obtained during the first two revolutions of the hand wheel or operating crank. The switch shall not interfere with the operation of the valve, nor obstruct the view of its indicator. The trouble signal shall be obtained during abnormal interconnecting circuit conditions. Devices shall be compatible with the fire alarm system and the requirements of NFPA 72. All switches shall be suitable for installation of end-of-line devices.

G. Pressure Gauges: Pressure gauges shall be the Bourdon-tube type with a metal corrosion-resistant case, flat glass window, 3½-in. diameter white background dial with black markings, and a 0-300 psig range. Gauge accuracy shall be 3-2-3% of full range. A shutoff valve shall be provided with each gauge connection.

2.4 DETECTION SYSTEM

A. Detection for the MDF Room preaction system shall be in accordance with Section 28 3111.

B. Complete design information shall be submitted with the sprinkler system shop submittal for review by the fire protection engineer in accordance with the specifications.

2.5 SUPERVISORY AIR SYSTEM

A. Air compressor: Provide an oilless piston-type compressor sized to fill the sprinkler system to the normal operating pressure within 30 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate the exact location for the preaction system riser near to the exterior wall. Refer to fire protection drawings. Final location of the preaction system riser is subject to the approval of the Architect and Engineer.

B. The penetration into the MDF Room shall be above the entry door so as not to interfere with the other wall mounted panels.

C. Water filled sprinkler pipe(s) above the MDF Room, other than the preaction system piping, shall not be permitted and shall be routed around the room.

3.2 INSPECTIONS AND TESTING

A. An air pressure leakage test at 40 psi shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 1.5 psi for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

B. Detection and Control System
   1. Upon completion of the installation, the detection and control system shall be subjected to functional and operational performance tests including tests of each installed initiating device, system actuation device and notification appliance. Testing shall be in accordance with NFPA 72. The test shall include the following:
      a. Visual inspection of wiring connections.
      b. Opening the circuit at each alarm initiating device, solenoid valve, and notification appliance to test the wiring and supervisory features.
      c. Test of each function of the RSFACU.
      d. Test of each circuit in the normal, open and ground fault modes.
      e. Test of each initiating device in both normal and trouble conditions.
      f. Test of each control circuit and device.
      g. Test of each alarm notification appliance.
      h. Operational tests under emergency power supply, including activation of connected alarm notification appliances for the specified time period.

C. Automatic Water Control Valve
   1. Each water control valve (deluge) shall be independently trip-tested in accordance with the manufacturer's published instructions. Each valve shall be electrically trip-tested by actuating a respective detector and a manual actuation station connected to the control panel (if provided) and a manual actuation device that is part of the valve trim. A full-flow main drain test shall be made. For preaction systems with supervisory air, the air pressure shall be reduced to verify proper operation of the air supply system and associated supervisory alarm devices.

2. Test results shall be witnessed and recorded. Test results shall include the number of seconds elapsed between the time the test valve is opened and tripping of the deluge valve, trip-point air pressure of the deluge valve, water pressure prior to valve tripping, and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice.

D. Supervisory Air
1. Supervisory air pressure shall be reduced from the normal system pressure to the point at which a low-pressure signal is generated. Air pressure shall be restored to verify trouble signal restoration.
2. Supervisory air pressure shall be increased above the normal system pressure to the point at which a high-pressure signal is generated. Normal air pressure shall be restored to verify trouble signal restoration.
3. Automatic start/stop features of air compressor shall be tested.

E. All operating parts, including electrical equipment, shall be fully tested to ensure their proper operation. All control valves shall be fully closed and opened under full system pressure, with the fire pump running.

F. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified two weeks in advance of the tests in order to arrange attendance at the tests.

G. The Contractor shall perform supplemental tests and shall render additional services in connection with the sprinkler system, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

3.3 TRAINING SESSIONS

A. Prior to project completion, the Contractor shall provide initial operational training to the Owner's key employees.

B. The Contractor shall arrange finalized training sessions at the convenience of the Owner. The sessions shall be completed as soon as possible following system acceptance. Each training session shall include details of the system interface and control.

~END OF SECTION~

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SECTION 21 3116

DIESEL DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
   1. Diesel engine-driven fire pump, electric motor-driven jockey pump, and associated controllers and equipment
   2. System design, installation, and certification

B. Work not covered by this Section
   1. Installation of portable fire extinguishers
   2. The wiring and monitoring of alarm switches and supervisory signaling system – (To be coordinated with the General Contractor)
   3. All electrical installations – (To be coordinated with the General Contractor)
   4. Underground fire service main installation
   5. Water storage (suction) tank
   6. Fire pump room, including all electrical, lighting, plumbing, heating/ventilation and other structural or environmental requirements – (To be coordinated with the General Contractor)
   7. Pump pads – (To be coordinated with the General Contractor)

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 21 4123 Ground Suction Storage Tanks for Fire Suppression Water

C. Section 28 3111 Intelligent, Addressable Fire Alarm System

D. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

E. Comply with other Divisions and Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 INTENT

A. It is the intent of this specification section to provide the Owner's minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.4 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable

to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.5 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed or FM Global (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, Engineer, insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the fire pump and/or fire sprinkler system subcontractor(s).

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code (“NCBC”)
   2. 2018 North Carolina Fire Code (“NCFC”)

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2013) – Standard for the Installation of Sprinkler Systems
   2. NFPA 20 (2013) – Standard for the Installation of Stationary Pumps for Fire Protection
   3. NFPA 24 (2013) – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
   4. NFPA 70® (2014) – National Electrical Code®
   5. NFPA 72® (2013) – National Fire Alarm and Signaling Code®
   6. NFPA 1963 (2014) – Standard for Fire Hose Connections

C. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

D. FM Global (FM)
   1. FM Global Approval Guide (most current edition including supplements)

1.7 SYSTEM DESCRIPTION

A. Fire Pump System:
   1. Provide fire pump and associated equipment complete and ready for operation. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 20, NFPA 24, NFPA 70, and NFPA 72, except as modified herein.
   2. The fire pump and its controller shall be located in the pump room, as indicated on the fire protection drawings. The installation shall include all piping, valves, lighting, heating, ventilation, auxiliaries and appurtenances specified and indicated in NFPA 20.
   3. Provide a pressure maintenance (jockey) pump and controller located within the fire pump room.
   4. Provide and arrange all pump equipment as generally indicated on the fire protection drawings and in a manner that allows maximum utilization of the space

as well as maximum access to equipment for maintenance and testing purposes. The contractor shall coordinate with other trades as necessary to avoid conflicts.

5. Fire pumps and jockey pumps shall take suction from two independent water sources. This includes a combination of the public water utilities, ground-level water storage tanks located adjacent to the fire pump room, or both, as indicated on the fire protection drawings. One fire pump shall be provided for each source.

B. Sprinkler Systems

1. Complete automatic sprinkler protection shall be provided for each fire pump room in accordance with NFPA 13, NFPA 20, and Section 21 1313.

C. Alarm and Supervisory Devices

1. Provide and install the following alarm and supervisory switches that shall be connected to the building fire alarm control unit (FACU) by the fire alarm contractor.
   a. Tamper Switches: All valves directly controlling water to the fire sprinkler system, and the valve controlling the fire pump test header, shall be provided with tamper supervisory devices. An off-normal signal shall be initiated during the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position, whichever is less. Each tamper switch shall initiate a distinct supervisory indication. Underground key operated valves are exempt from this requirement.
   b. Fire Pump Monitoring: Monitor the following conditions from the fire pump controller:
      1) Engine running condition (addressable supervisory)
      2) Controller main switch not in “Auto” (addressable supervisory)
      3) Low pump room/house temperature (addressable supervisory)
   c. Means shall be provided to monitor the following conditions via the fire alarm system as separate, distinct points; refer to controller manufacturer for all distinct points and whether they are engine, pump room/house, or controller signals:
      1) General engine trouble (addressable supervisory)
      2) General pump room/house trouble (addressable supervisory)
      3) General controller trouble (addressable supervisory)
   d. Means shall be provided to monitor the following conditions via the fire alarm system as separate, distinct points:
      1) Off-normal water level, 3 in. high (addressable supervisory)
      2) Off-normal water level, 3 in. low (addressable supervisory)
      3) Low water level (4 in. below normal) (addressable supervisory)
   e. Means shall be provided to initiate the water tank fill line through a solenoid valve. Functionality shall be provided in accordance with the fire protection drawings.
   f. Waterflow Switches: The sprinkler riser in the fire pump room shall be provided with a vane-type waterflow device. Waterflow signals shall be priority signals that shall identify the flow device that is activated.
2. Alarm and supervisory switches shall be in accordance with Section 21 1313. Monitoring by the building fire alarm control unit shall be in accordance with Section 28 3111.

D. Provide and install all aboveground and underground piping required for a complete and usable fire pump installation in accordance with Section 21 1313, except as modified herein.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Submittal packages shall be submitted with the

sprinkler system shop submittal package. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Drawings: Show detail plan view of the fire pump room including elevations and sections showing the fire pump, associated equipment, and piping. Plans, elevations, and sections shall be drawn to scale and shall indicate that the proposed arrangement of equipment will fit in the space provided. Show piping schematic of pumps, devices, valves, pipe, and fittings. Provide an isometric drawing of the fire pump and all associated piping. Show point-to-point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Prepare an electronic set of working drawings (in PDF format) on sheets not smaller than 24 in. x 36 in. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work.

B. Product Data: Submit an electronic set of descriptive data (in PDF format) annotated to show the specific model, type, and size of each item proposed. Full descriptive data, including, but not limited to, pressure/flow curves, selected options, wiring diagrams, schematics, etc. shall be submitted for all components essential to proper installation. Submit manufacturer's certified test characteristic curves for each pump, including pump discharge curves, with the corresponding shop test data points. Submittal must be approved in writing by the Engineer and the Authorities Having Jurisdiction prior to starting work. Include:
1. Fire pump
2. Driver
3. Fire pump controller
4. Pressure maintenance pump and controller
5. Devices, materials and associated equipment
6. Hose valve manifold test header

C. Installation, Operation, and Maintenance Data: Submit two (2) complete sets of the equipment manufacturer’s installation, operation and maintenance data for each fire pump, driver, controller, and other related equipment. Data shall be submitted bound together in a 3-ring notebook or other approved manner, with indexed tabs separating the data for each piece of equipment. Include, as applicable:
1. Safety precautions
2. Normal operations
3. Emergency operations
4. Environmental conditions
5. Lubrication data
6. Preventive maintenance plan and schedule
7. Troubleshooting guides and diagnostic techniques
8. Wiring diagrams and control diagrams
9. Maintenance and repair procedures
10. Removal and replacement instructions
11. Spare parts and supply list
12. Parts identification
13. Warranty information
14. Testing equipment and special tool information
15. Contractor information

D. Submittals to the Authorities Having Jurisdiction

Submit shop drawings and product data directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities’ field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

E. Project Record Documents

1. Sprinkler Contractor's Superintendent shall prepare, on a daily basis, redlined shop drawings to record as-built conditions. Submit completed redlined drawings to the Engineer at project completion.
2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on reproducible vellum.

1.9 QUALITY ASSURANCE

A. Qualifications
1. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of fire pumps. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
2. Contractor shall be a firm specializing in performing work of this Section with a minimum of three years' experience and must be regularly engaged in making such installations.
3. Contractor shall have successfully installed fire pump systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify each system has performed satisfactorily in the manner intended for a period of not less than 18 months.
4. Contractor shall provide workers normally employed in the field and as otherwise specified in NFPA 13 and local ordinances.
5. All material shall be new and in good condition, free of defects, scratches, corrosion and contamination. Used equipment shall not be allowed.

B. Equipment and components shall bear the markings indicating the equipment or component is UL listed and/or FM approved.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 13, NFPA 20, and NFPA 24, as applicable; to other applicable NFPA standards; to all Local, State and Federal codes; and to all other requirements specified herein. The advisory provisions (Appendices/Annexes) of the NFPA publications referred to herein shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer at the Engineer's discretion.
2. Shop drawings, product data, and hydraulic calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal's office.
3. Deviations from the contract documents and the contractor's approved submittal documents will not be permitted without written consent from the Engineer.
4. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 13, NFPA 20, NFPA 24, Local, State, or Federal requirements, and the requirements of the Authorities Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment and valves in shipping containers, with labeling in place. Maintain in place, protected from the environment, until installation.

1.11 SEQUENCING

A. Fire pump acceptance testing must be completed prior to the flushing of all underground fire service mains on the site. Filling of sprinkler systems with water prior to complete flushing shall only be permitted by special permission of the Engineer after appropriate filling procedures have been submitted and approved.

1.12 GUARANTEE

A. The Contractor, in addition to other warranties or guarantees required by the contract documents, shall guarantee workmanship on all piping, devices, and related materials for a period of one (1) year from the date of the Engineer's final acceptance of the work. All defects shall be promptly corrected at no cost to the Owner.

B. The Contractor is responsible for providing a system that has been coordinated with the contract documents and approved by all concerns referenced in this document, including, but not limited to, the Owner, local authorities, and the Owner's representatives.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment supplied under this specification shall be new and shall be UL listed and FM approved for fire protection service and installed and used as intended by the listing.

2.2 FIRE PUMP EQUIPMENT

A. Each installation shall include a hose valve header, hose valves with caps and chains, automatic air release valve, circulation relief valve, eccentric and concentric reducers (as applicable), suction and discharge gauges, and all other devices and appurtenances as required by NFPA 20.

B. Diesel Engine-Driven Fire Pump

1. The fire pump shall be a diesel engine-driven horizontal split-case, centrifugal fire pump. Pump ratings (gpm) shall be as indicated on the fire protection drawings. The pressure rating shall be determined by the fire sprinkler contractor's sprinkler system hydraulic calculations. Refer to fire protection criteria drawings for a basis of design fire pump selection. Final fire pump selection shall be submitted to and approved by the Engineer.
2. Maximum pressure downstream of the fire pump shall not exceed 175 psig. The use of a main pressure relief valve to limit system pressures to meet this requirement shall not be permitted. A main pressure relief valve shall only be provided in accordance with NFPA 20 and these specifications, if necessary. The discharge pressure downstream of the fire pump shall be permitted to be limited by variable speed pressure limiting control in accordance with NFPA 20 and these specifications. The maximum fire pump discharge pressure shall be calculated using the maximum static pressure expected at the suction flange of the pump and the net churn (no-flow) pressure from the fire pump.
3. The fire pump shall start automatically whenever system pressure on the discharge side of the pump is reduced to a preset start point, and manually whenever the start button is depressed. The pump shall continue to run after a start signal is received and shall be configured to run until manually stopped.

2.3 FIRE PUMP DRIVER

A. Diesel Engine Driver

1. Diesel engine driver shall be listed per UL 1247 and/or FM-approved for fire pump service and shall be of the make and power rating recommended by the pump manufacturer for the pump being provided. Engine power shall be adequate to drive the pump at all conditions of speed and load over the full range of the pump performance curve. Engine power shall be per SAE conditions, properly derated for temperature and altitude as required by NFPA 20.
   a. Engine shall be derated for an assumed combustion air temperature of 120°F.
   b. Engine shall be derated for actual installed elevation.
2. Diesel engine shall be of the compression ignition type with electric starting device taking current from two battery units that are rack-mounted not less than 12 in. above the floor. The engine shall be equipped with an engine block heater, dual battery contactors capable of mechanical operation to energize the starting motor in the event of control circuit failure, and an emergency manual fuel solenoid valve. The engine shall be arranged for 12- or 24-volt operation. Contractor shall provide heavy-duty commercial lead acid batteries for dual operation, battery rack, battery cables, and electrolyte. The diesel engine driver shall meet all applicable local regulations.
3. Fuel System External to Engine
   a. Provide in accordance with NFPA 20 and NFPA 37. Provide vent piping with weatherproof vent cap discharging to the exterior. Provide flexible bronze or stainless steel piping connectors with single braid at each piping connection to diesel engine. Supply, return, vent, and fill piping shall be steel piping.
      1) Steel Pipe: ASTM A 53, Weight Class XS (Extra Strong), black steel, threaded end connections. Provide ASME B16.3 threaded fittings and ASME B16.39 threaded unions.
   b. Tanks: Double-walled construction in accordance with UL 80 or UL 142 for aboveground steel tanks. Provide bottom drain connection to annular space for connection of leak detection sensor. Provide bottom drain valve and plug connected to internal fuel tank to allow purge of sump volume. Provide low fuel level sensor for monitoring by controller.
      1) Leak Detection Sensor: Model FLS-TS manufactured by Chicago Technical Sales, Inc., or approved equal
   c. Valves: Provide valves suitable for fuel oil service. Valves shall have union end connections or threaded end connections.
         a) Gate, Globe, and Angle Valves: MSS SP-80, Class 125
         b) Check Valves: MSS SP-80, Class 125, swing check
         c) Ball Valves: Full port design, copper alloy body, two-position lever handles
4. Exhaust System External to Engine
   a. Provide in accordance with NFPA 20 and NFPA 37. Provide exhaust mufflers to reduce noise levels less than 85 dBA. Exhaust shall discharge to the exterior.
      1) Steel Pipe: ASTM A 53, Weight Class XS (Extra Strong), black steel, welding end connections. Provide ASME B16.9 or ASME B16.11 welding fittings of the same material and weight as the piping.
      2) Flanges: ASME B16.5, Class 150. Provide flanges at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 0.0625 in. thick. Provide ASTM A 193/A 193M, Grade B7 bolts and ASTM A 194/A 194M, Grade 7 nuts.

3) Piping Insulation: Products containing asbestos will not be permitted. Provide exhaust piping insulation system inside the fire pump room. Provide a finished stainless steel jacket over insulation.

2.4 FIRE PUMP CONTROLLER

A. Controller shall be the automatic type and UL listed and/or FM approved for fire pump service. Pump shall be arranged for automatic start and manual push-button stop. Means for allowing automatic stop of the fire pump motor under other than test conditions shall not be connected. Controller shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 2 drip-proof enclosure arranged so that controller current carrying parts will not be less than 12 in. above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a Bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps, and supervisory power light.

B. Diesel Engine Controller

1. Controllers shall be approved for diesel engine-driven fire pump service.
2. Controller shall be equipped with two battery chargers, two ammeters, and two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller operating voltage shall match the diesel engine driver.
3. Controller shall be equipped with the following supervisory alarm functions, and other applicable signals in accordance with the manufacturer:
   a. Engine Trouble (individually monitored)
      1) Engine overspeed
      2) Overpressure
      3) Low Oil Pressure
      4) High Water Temperature
      5) High Discharge Pressure
      6) Engine Failure to Start
      7) Battery
      8) Battery Charger/AC Power Failure
      9) ECM selector switch in alternate ECM position (for engines with ECM controls only)
      10) Fuel injection malfunction (for engines with ECM only)
   b. Main Switch Not in Auto (i.e., in Manual or Off)
   c. Pump/Engine running
   d. Low pump room/house temperature
   e. Fire pump room/house trouble (individually monitored)
      1) Low fuel level. Signal at two-thirds tank capacity
      2) Fuel tank leak
   f. Controller trouble
      1) Battery charger fail

   Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set.
4. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, engine running (two sets), engine trouble and fire pump room trouble, and terminals for remote start.
5. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or fire pump room trouble alarm condition and alarm silence switch.
6. The controller shall be equipped with a weekly program timer with the capability to automatically start and run the engine for a test period of at least 30 minutes once per week. If during this test period the engine develops critically low lubricating oil pressure or high engine jacket coolant temperature, the controller shall initiate a

"trouble on engine or controller" alarm as required by NFPA 20 and stop the engine. While in this stopped condition, if any other starting input is received by the controller, the controller shall restart and run the engine as required by NFPA 20.

7. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.
8. Provide controller with digital pressure readout which displays water system pressure, and paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory.

2.5 PRESSURE MAINTENANCE PUMP

A. A pressure maintenance (jockey) pump shall be provided with the driver, controls, and pump accessory items specified by the pump manufacturer. The pump shall be electric-driven, centrifugal type with a rated capacity as indicated on the fire protection drawings. Provide approved, indicating, and supervised isolation valves in the jockey pump suction and discharge piping. Provide pressure gauge and approved check valve in the jockey pump discharge outlet.

B. The pressure rating shall be selected to allow the system pressure to be maintained at a minimum pressure at least 10 psi greater than the rated fire pump churn pressure plus the minimum available static pressure, but no more than 225 psi. A listed pressure relief valve shall be provided on the jockey pump discharge piping if the discharge pressure will exceed 175 psi; the wastewater from the relief valve shall be piped to the floor drain or exterior.

C. Fire pump shall take suction directly from the public water utility and suction tank as indicated on the fire protection drawings and shall discharge into the system on the downstream side of the pump discharge control valve.

2.6 PRESSURE MAINTENANCE PUMP CONTROLLER

A. Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. The controller shall be equipped with monitoring for pump starts and elapsed run time, tell-tale light, and reset button (TornaTech Model JP3-Z139 or approved equal).

2.7 PRESSURE SENSING LINES

A. A completely separate pressure sensing line shall be provided for the fire pump and for the jockey pump. The sensing line shall be arranged in accordance with NFPA 20. The sensing line shall be ½-in. brass or copper tubing.

B. Each sensing line shall be equipped with two check valves. Each check valve shall have a 3/32-in. orifice drilled in its clapper. Check valves shall be mounted not less than 5 ft. apart on the sensing line.

C. A test connection shall be provided for each sensing line. Test connection shall consist of a brass ½-in. globe valve and ¼-in. gauge connection tee arranged per NFPA 20. The test connection shall be equipped with a 0 to 300 psi (cold water pressure) oil-filled gauge.

D. Each sensing line shall be connected to its respective pump discharge piping between the discharge piping control valve and the check valve.

2.8 PRESSURE RELIEF VALVES

A. ½- or ¾-in. relief valves shall be direct acting, spring loaded, diaphragm type specifically listed for fire protection system service.
   1. Pressure setting shall be adjustable by turning an adjustment screw to vary the spring loading on the diaphragm. The pressure adjustment setting shall be of a type that can be sealed/ locked to prevent tampering. The pressure range of the setting shall be from 175 psi to 310 psi.
   2. Relief valve shall be the Globe Model ARV Adjustable Relief Valve (GFV-575), or equivalent.

2.9 ABOVEGROUND PIPING SYSTEMS

A. Aboveground piping, valves, and appurtenances shall be per Section 21 1313, except as specified herein.

B. Fire Pump Test Header: Provide hose valve manifold with 2½-in. hose gate valves with caps and chains. Hose threads shall be American National Fire Hose Connection Screw Threads (NH) conforming to the requirements of NFPA 1963. Final number of hose gate valves to be determined based on size (gpm) of fire pump – provide number of valves in accordance with NFPA 20.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate the work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment, and shall take any necessary measures to keep the premises dry at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Prior to the operation (opening or closing) of any valve controlling water to the domestic or fire system, notification shall be given to, and approval obtained from, the General Contractor.

D. The A/E, Developer and Owner shall NOT be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. The responsibility rests with the Contractor.

E. Ream pipe and tube ends. Remove burrs and fins.

F. Prepare piping connections to equipment with flanges or unions.

G. All excess oil, dirt, pipe joint compound, rust, mill scale, and factory coatings shall be removed from piping and equipment. All dirt, debris and excess cutting oil shall be removed from the interior of all piping and equipment before it is erected.

3.2 INSTALLATION

A. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA Standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean. All wiring shall be in metal conduit.

B. Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 13 and NFPA 20, as well as the requirements of the

local Authorities Having Jurisdiction. In addition, the fire pump, driver, and controller shall be installed in accordance with the written instructions of the manufacturer.

C. Contractor shall coordinate the layout of equipment, piping and materials to be located within the Fire pump room with the General Contractor to assure sufficient space and openings to accommodate the entire installation, and accessibility for maintenance and replacements, if necessary.

D. Where required by manufacturer, properly torque bolts to manufacturer's specifications using a torque wrench.

E. The Contractor shall install the piping and equipment in accordance with approved shop drawings.

F. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

G. Provisions shall be made by the Contractor to protect fire pump equipment from exposure to elements or extreme climatic conditions, including freezing and high temperature, until accepted by the Owner.

H. Pump circulation relief valve discharge and packing gland weepage connections shall be routed separately to floor drain or exterior. Route pipe to avoid creating trip hazards. Floor drain shall discharge as required by the local sanitation authority.

I. Provide pipe stands and hangers in accordance with NFPA 13 and NFPA 20.

J. All wiring from the fire pump controller to the engine control panel shall be in rigid metal conduit, intermediate metal conduit, or liquid-tight flexible conduit. Where the conduit is run along a wall or the floor, the bottom of the conduit shall be located at least 12 in. above the fire pump room floor.

K. Sequence of operation shall be as indicated on fire protection drawings. Automatic shutoff capabilities (e.g., run timer) shall not be installed or connected.

L. The fire pump test header shall be provided with a ball drip valve arranged to discharge to the exterior.

3.3 INSPECTIONS AND TESTING

A. The system shall be subject to inspection and acceptance by the Engineer and the Authorities Having Jurisdiction for the purpose of determining the system is in accordance with federal, state, local and specification requirements, applicable standards of the NFPA, and other related codes and standards.

B. The Contractor shall be responsible for performing and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification.

C. Inspection test procedures shall be submitted to the Engineer for approval prior to use.

D. All field tests performed by the Contractor shall be conducted in the presence of the Engineer and other representatives at the Owner's option. All persons concerned shall be notified a minimum of two weeks in advance of the tests in order to arrange attendance at the tests.

E. All connections related to the fire pump system, including, but not limited to, electrical and piping connections, shall be completely and permanently installed prior to the final fire pump acceptance test.

F. Final Acceptance Test

1. The contractor shall provide portable radios, hoses, nozzles, calibrated pitot gauges, calibrated pressure gauges, digital tachometer, volt/ammeter and any other equipment and personnel required to conduct a complete fire pump acceptance test. Certificates of gauge calibration no more than 6 months old shall be presented to the Engineer and the Authorities Having Jurisdiction prior to commencement of the acceptance test. The certificates shall be NIST traceable and provide the necessary corrections to the indicated gauge pressure at not less than 4 pressure points for each gauge.
2. Factory Authorized Representatives from the fire pump manufacturer, diesel engine driver manufacturer, and fire pump controller manufacturer shall be present for the complete operational testing of the fire pump and driver. The fire pump controller and diesel engine manufacturer's representative shall be an experienced technician employed by the manufacturer and capable of demonstrating operation of all features of the components including trouble alarms and operating features.
3. Fire pump room electrical wiring to the fire pump driver, controller, inter-wiring, normal power supply, alternate power supply, and jockey pump shall be complete and checked by the electrical contractor prior to initial startup and acceptance test. Written documentation shall be provided prior to acceptance test to confirm all electrical wiring has been checked and is in proper working order, in accordance with these specifications, NFPA 20, and NFPA 70.
4. Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the Contractor to the Engineer prior to the time of the pump acceptance test.
5. Flow Tests
   a. Flow tests using the test header, hoses and playpipe nozzles (or other approved outlets) shall be conducted. For a variable speed pressure limiting controlled fire pump, two complete flow tests shall be performed – one with the fire pump operating at rated speed and one in variable speed mode.
      1) Any pump (variable speed or not) shall be flow tested at churn (no flow), 25, 50, 75, 100, 125 and 150 percent capacity. This shall constitute the rated speed condition.
      2) A PLD-controlled (i.e., variable speed) pump shall also be completely flow tested at churn (no flow), 25, 50, 75, 100, 125, and 150 percent of rated capacity. This shall constitute the variable speed condition.
   b. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Pump speed (rpm), suction pressure and discharge pressure readings shall be taken as part of each flow test.
   c. The securing of all hoses and nozzles during the tests is the responsibility of the contractor. Water flow testing shall be conducted in a safe manner with no destruction to the existing facility or new construction. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test at no additional charge to the Owner.
6. Starting Tests
   a. Pumps shall be tested for automatic starting.
   b. Setting of the pressure switches shall be tested when pumps are operated by pressure drop.
   c. Tests may be performed by operating the test connection on the pressure sensing lines.
   d. As a minimum, the pump shall be started automatically 6 times and manually 6 times, in accordance with NFPA 20.
   e. The fire pump shall be in operation for at least 60 minutes during the acceptance testing.
7. Alarms: All pump alarms, both local and remote, shall be tested.

8. Miscellaneous
   a. Proper operation of pressure relief valves shall be verified following the testing of the fire pump.
   b. Valve tamper switches shall be tested.
   c. Pressure recorder operation, relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.
9. Correction of Deficiencies: If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.
10. Acceptance Test Documentation: Upon completion of required testing, submit complete pump acceptance test data. The pump acceptance test data shall be on forms that give detailed pump information such as that which is indicated in the Appendix of NFPA 20. All test data records shall be submitted with the Project Record Documents.

G. At the conclusion of the acceptance testing, the Contractor shall top off the diesel fuel tank in the fire pump room so that it is turned over to the Owner filled with fuel.

H. The Contractor shall perform supplemental tests and shall render additional services in connection with the fire pump equipment, as directed. The cost, if any, will be negotiated prior to the test. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

~END OF SECTION~

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SECTION 21 4123

GROUND SUCTION WATER STORAGE TANK FOR FIRE PROTECTION

PART 1 - GENERAL

1.1 SCOPE

A. Contractor shall assume two (2) fire water storage tanks are required and include a Bid Alternate Deduct for a single (1) tank.

B. Work covered by this Section:
   1. Welded steel ground-level water storage tank for fire protection, including foundation, structure, interior and exterior coating systems, and appurtenances.

C. Work not covered by this Section:
   1. The wiring and monitoring of alarm switches and supervisory signaling system – (to be coordinated with the General Contractor)
   2. All electrical installations - (to be coordinated with the General Contractor)
   3. Fire pumps and equipment
   4. Fire pump house, including all electrical, lighting, plumbing, heating/ ventilation and other structural or environmental requirements – (to be coordinated with the General Contractor)

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 21 1317 Preaction Fire Sprinkler System

C. Section 21 3116 Diesel Drive, Centrifugal Fire Pump

D. Section 28 3111 Intelligent, Addressable Fire Alarm System

E. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

F. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (UL) listed and/or FM Global (FM) approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the private underground fire service mains and/or fire sprinkler system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner's minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner. The Contractor is responsible to prepare all plans, calculations, and permit applications; to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code ("NCBC")
   2. 2018 North Carolina Fire Code ("NCFC")

B. National Fire Protection Association (NFPA)
   1. NFPA 13 (2013) – Standard for the Installation of Sprinkler Systems
   2. NFPA 20 (2013) – Standard for the Installation of Stationary Pumps for Fire Protection
   3. NFPA 22 (2013) – Standard for Water Tanks for Private Fire Protection
   4. NFPA 24 (2013) – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
   5. NFPA 70® (2014) – National Electrical Code®
   6. NFPA 72® (2013) – National Fire Alarm and Signaling Code®
   7. NFPA 1963 (2014) – Standard for Fire Hose Connections

C. The advisory provisions (Appendices/Annexes) of the above referenced NFPA publications shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

D. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

E. FM Global (FM)
   1. Approval Guide (most current edition including supplements)

F. American National Standards Institute (ANSI)
   1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose
   2. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
   3. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300
   4. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250
   5. ANSI/ASME B16.5 - Steel Pipe Flanges and Flanged Fittings
   6. ANSI/ASME B16.9 - Factory-made Wrought Steel Buttweld Fittings

7. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welded and Threaded
8. ANSI/ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
9. ANSI/ASME B16.25 - Buttwelded Ends for Pipe, Valves, Flanges, and Fittings
10. ANSI/ASME B36.10M - Wrought Steel Pipe

G. American Society for Testing and Materials (ASTM)
1. ASTM A53 - Welded and Seamless Steel Pipe
2. ASTM A126 - Gray Iron Castings for Valves, Flanges, Pipe Fittings
3. ASTM A135 - Electric-Resistance-Welded Steel Pipe
4. ASTM A183 - Carbon Steel Track Bolts and Nuts
5. ASTM A193 - Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service
6. ASTM A194 - Carbon and Alloy Steel Nuts and Bolts for High Pressure and High-Temperature Service
7. ASTM A197 - Cupola Malleable Iron
8. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
9. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
10. ASTM F436 - Hardened Steel Washers
11. ASTM A536 - Ductile Iron Castings

H. American Welding Society (AWS)
1. WS D10.9 - Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

I. American Water Works Association (AWWA)
1. AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
2. AWWA C110 - Ductile Iron and Gray Iron Fittings, 3 in. through 48 in., for Water and Other Liquids
3. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
4. AWWA C115 - Flanged Ductile Iron Pipe and Threaded Flanges
5. AWWA C150 - Thickness Design of Ductile Iron Pipe
6. AWWA C151 - Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
7. AWWA C153 - Ductile Iron Compact Fittings, 3 in. through 12 in., for Water and Other Liquids
8. AWWA C502 - Dry-Barrel Fire Hydrants
9. AWWA C509 - Resilient-Seated Gate Valves for Water and Sewerage Systems
10. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances
11. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 12 in., for Water
13. AWWA D100 Welded Steel Tanks for Water Storage
14. AWWA D102 Coating Steel Water Storage Tanks

1.7 SYSTEM DESCRIPTION

A. Water storage tank shall be furnished by the fire sprinkler contractor as part of the fire sprinkler subcontract.

B. Design and Construction Standards
1. The design, fabrication, and erection of the tank shall be in accordance with the applicable requirements of NFPA 22 and AWWA D100 except as may be modified herein.
2. Seismic design, if required, shall be in accordance with the building code, NFPA 22, and AWWA D100.
3. The tank shall be designed for peak wind speeds and snow loads are required by the local building code, NFPA 22, or AWWA D100, whichever is greater.

4. No additional thickness for corrosion allowance will be required.

C. Design Requirements

1. The tank shall have a minimum usable storage capacity of 100% of the required demand (as measured between the inlet of the overflow and the level of the vortex plate) for a period of 3 hours (i.e., 180 minutes). Tank diameter and straight wall height shall be determined by the tank manufacturer to satisfy this requirement. Refer to drawings for minimum tank volume.
2. The tank shall have a supported cone roof with a roof slope of at least 1:12.
3. The tank shall be of welded construction.
4. The tank shall be provided with the following nozzles/ connections to be located within the fire pump house. Final size and location of all nozzles and connections shall be determined by the fire sprinkler contractor on their approved shop drawings and coordinated with the tank supplier:
   a. One flanged fill connection tied to an over-the-top interior fill pipe riser located at the center post. Connection to the water supply main shall be via an OS&Y control valve. Provide a backflow prevention device within the fire pump room in accordance with the fire protection drawings.
      1) Fill line shall discharge in opposite half of tank from the fire pump suction nozzle and shall include a 12 in. air gap between the outlet of the fill line and the overflow inlet.
   b. One flanged suction nozzle for fire pump with interval elbow and minimum 24-in. by 24-in. anti-vortex plate; anti-vortex plate shall be set at least 6 in. above the tank floor.
   c. One flanged suction nozzle for jockey pump.
   d. Two flanged nozzles for immersion heaters.
   e. Connection for temperature probe.
5. The tank shall be provided with a final design to safely vent the tank when filing or drawing down at a maximum rate. Vent shall be screened in accordance with the requirements of NFPA 22.
6. Tank shall be provided with an anti-vortex overflow and stub pipe at the top of the tank. The overflow pipe shall be at least one pipe size larger than the fill line and shall be equipped with an inlet such as a concentric reducer, or equivalent that is at least 2 in. larger in diameter. Overflow shall be adequately screened and protected to prevent the access of birds and insects.
7. Tank shall be provided with water level float switches at the high and low water levels for monitoring by the fire alarm system in accordance with fire protection and fire alarm drawings.
8. The tank shall be provided with all manways, ladders, hatchways, safety rails, exterior float level gage, high and low water level float switches, lightning protection, and other openings and equipment as required by NFPA 22.
9. Tank shall be designed to be anchored to the foundation. Anchorage attachments shall be designed such that the anchor bolt yields before the shell attachment fails.
10. Tank shall be designed such that the coldest water in the tank is no less than 42°F during the coldest weather, in accordance with NFPA 22. Tank shall be provided with heat and insulation as appropriate for the climate.

1.8 SUBMITTALS

A. Only complete submittal packages, which include all required drawings, certifications, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed. Electronic submittals in PDF format shall be prepared in accordance with Division 01 Submittal Procedures.

B. Shop Drawings:

1. Foundation: Ring wall foundation designed in accordance with NFPA 22 and AWWA D100 based on information available in the site Soils Report.

2. Structure: Detail and erection drawings, before proceeding with any fabrication. The drawings shall be complete with details of all steel, pipe, and concrete work and with details of the assembling of all items required for the complete installation. Standard welding symbols as recommended by the American Welding Society shall be used. Details of all joints referenced on the drawings shall also be included.
3. Construction drawings for the tank structure and foundation shall bear the certification of a professional engineer licensed in the jurisdiction where the tank is to be erected.

C. Product Data
1. Tanks including accessories and components
2. Coating systems
3. Detailed specifications, inspection and testing procedures, available performance test data, and instructions for maintenance.

D. Heat Loss Calculation

E. Test Reports
1. Copies of the following test results
   a. Manufacturer’s mil test reports for plate material
   b. After acceptance of the structure, the radiographic film and/or test segments
2. At the conclusion of the work, a written report prepared by the Contractor certifying that the work was inspected in accordance with Section 11 of AWWA D100. The report shall also cover the hydrostatic and vacuum box leak tests and shall meet the requirements of Section 11.2.1 of AWWA D100 for welded tanks.

F. Certificates
1. A certificate signed by a registered professional engineer providing the following information:
   a. Description of the structural design loading conditions used for the design of entire tank including the foundation
   b. Description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design.
   c. A statement verifying that the structural design has been checked by experienced engineers specializing in hydraulic structures
   d. A statement verifying that the detail drawings have been checked by experienced engineers specializing in hydraulic structures to determine that they agree with the design calculations in member sizes, dimensions, and fabricating process as prescribed by the applicable AWWA standards.
2. Where foundation and tank drawings are prepared by separate parties, each party shall provide a separate certification.

1.9 QUALITY ASSURANCE

A. Qualifications
1. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of sprinkler systems. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
2. Contractor shall be a firm specializing in performing work of this Section with a minimum of three (3) years of experience and must be regularly engaged in making such installations.

3. Contractor shall have successfully installed automatic fire sprinkler systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The Contractor shall submit a copy of a valid state sprinkler contractor certificate and license, as applicable.
4. Contractor shall provide workers normally employed in the field and as otherwise specified in NFPA 22 and local ordinances.
   a. Welders used for the erection of welded steel tanks shall meet the requirements of Section 8.2 of AWWA D100, Qualifications of Welding Procedures, Welders, and Welding Operators for Welded Tanks.
5. All material shall be new and in good condition, free of defects, scratches, corrosion and contamination. Used equipment shall not be permitted.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-Listed and/or FM-Approved.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 22 and NFPA 24, to other applicable NFPA standards, to all Local, State and Federal codes, and to all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, product data, and hydraulic calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal’s office.
3. Deviations from the contract documents and the contractor's approved submittal documents will not be permitted without written consent from the Engineer.
4. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 13, Local, State, or Federal requirements, and the requirements of the Authorities Having Jurisdiction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Handle and store water storage tank systems, components, and parts to prevent distortions and other damage that could affect their structural, mechanical, or electrical integrity. Replace damaged items that cannot be restored to original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling.

B. Deliver paint in unopened containers with unbroken seals and labels showing designated name, specification number, color, directions for use, manufacturer, and date of manufacture, legible and intact at time of use.

1.11 GUARANTEE

A. The Contractor, in addition to other warranties or guarantees required by the contract documents, shall guarantee workmanship on all piping, devices, and related materials for a period of one (1) year from the date of the Engineer’s final acceptance of the work. All defects shall be promptly corrected at no cost to the Owner.

B. The Contractor is responsible for providing a system that has been coordinated with the contract documents and approved by all concerns referenced in this document including, but not limited to, the Owner, local authorities, and the Owner's representatives.

1.12 NAMEPLATE

A. Provide a nameplate for the water storage tank indicating the following information:
1. Name and address of tank manufacturer;
2. Year of assembly;
3. Height and diameter of shell;
4. Total net water capacity available for fire protection;
5. Marking of approval (e.g., UL, AWWA, FM)

B. The nameplate shall be permanently mounted to the tank on a mounting bracket welded to the tank shell.

PART 2 - PRODUCTS

2.1 GENERAL

A. Water storage tanks for fire protection shall be in accordance with NFPA 22.

B. Materials and workmanship shall be in accordance with NFPA 22.

2.2 FOUNDATION

A. The tank shall be set upon a foundation designed and specified by the tank manufacturer and constructed by the general contractor. The foundation design shall be based upon the soil bearing capacity determined by a geotechnical analysis performed by a licensed soils engineer. The results of such analysis shall be provided to the manufacturer by the contractor. The foundation design shall be in accordance with the provisions of NFPA 22 and AWWA D100. The foundation shall be capable of supporting the water-filled tank without settlements which compromise the structural integrity or liquid-tightness of the tank.

B. Foundation shall be designed with anchors to secure the tank to the foundation during seismic activity or high winds. The lower ends of the anchor bolts shall be hooked or fitted with an anchor plate.

2.3 INTERIOR AND EXTERIOR COATINGS

A. Priming Coat
1. All interior surfaces that are exposed to water immersion or the vapor phase zone above the overflow inlet shall be cleaned by near-white blasting in accordance with SSPC SP 10, or pickling in accordance with SSPC SP 8, and shall be primed in accordance with the requirements for “Inside Paint System No. 1” in AWWA D102.
2. All exterior surfaces shall be cleaned by commercial blasting in accordance with SSPC SP 6, or pickling in accordance with SSPC SP 8, and shall be primed with one coat of lead-free alkyd in accordance with the requirements for “Outside Paint System No. 1” of AWWA D102.

B. Finish Coat
1. All finish coat painting for interior surfaces (exposed to stored water) shall be in accordance with the requirements for “Inside Paint System No. 1” of AWWA D102, using the same basic system throughout.
2. Finish coat painting for all exterior and interior surfaces not exposed to stored water shall be in accordance with the requirements for “Outside Paint System

No. 1" of AWWA D102, using two coats of aluminum or alkyd enamel in a color, as specified by the Owner, to provide a minimum total system dry (not exposed to stored water) film thickness of 3.5 mils (0.09 mm) for aluminum finishes and 4.5 mils (0.1 mm) for alkyd enamels.

2.4 FREEZE PROTECTION (IF REQUIRED)

A. Tank heaters shall consist of two (2) 10-kW electric immersion heaters (480 V, 3 phase) with an Aquastat (or approved equivalent) set to maintain the temperature to no less than 42°F and no higher than 45°F.

B. The water tank shall be insulated to an R value of no less than 10 hr-sq ft-°F/ Btu utilizing an approved vertical sidewall metal-jacketed rigid insulation system suitable for painting. Color specification shall be selected by the Owner prior to order.

2.5 ACCESSORIES AND APPURTENANCES

A. The water storage tank shall be equipped with a suction pipe and anti-vortex plate, fill connection, two 24-in. shell manways, exterior liquid level indicator, exterior ladder with safety device, two interior ladders rising to two 24-in. roof hatches, 360° OSHA approved roof top handrail, vents, overflow pipe outlet, connections for temperature probe, water level float switches, and other accessories, and all other features as required by NFPA 22 and AWWA D100.

B. High/Low tank water level alarm indicating devices shall be provided using a UL-Listed and/or FM-Approved tank water level float switch. The switch shall be capable of detecting a 3-in. rise or fall of the water level in the tank and shall have two sets of dry contacts (one for high level, and one for low level) for connection to the fire pump controller and/or directly to the fire alarm system using addressable input modules.

PART 3 - EXECUTION

3.1 ERECTION

A. Welded Steel Tank

1. Erection operations shall be performed in strict accordance with AWWA D100.
2. Welding shall be performed only by operators who are qualified in accordance with the American Welding Society and the requirements of AWWA D100. Credentials for each welder's qualifications shall be made available for inspection upon request of the Engineer at the jobsite.
3. The work at all times shall be open to the Engineer for inspection.
4. Interior and exterior tank coating systems shall be applied in strict accordance with AWWA D102, as well as the recommendations of the coating manufacturer, including provisions for surface preparation, application, and verification of coating application. Coatings shall not be applied until satisfactory completion of the liquid tightness testing, as described below. Apply coatings by first brushing all edges, angles, flanges, openings, and sharp corners, allowing the application to dry; then apply coating to the remaining surfaces through either spraying or roller application methods. If applied by rollers, finish strokes shall be uniform and in the same direction. The advisory provisions of AWWA D102 Appendix apply as if the word "shall" replaces the word "should" throughout the text therein.
5. Tank heaters shall be provided in accordance with the requirements of NFPA 22 to maintain a minimum water temperature of 42°F. Tank heater set points shall be staggered such that not more than one heater will start simultaneously. Heaters and associated connections to the tank shall be located within the boundaries of the fire pump house. Coordinate all utility requirements for the selected/ approved tank heaters with the General Contractor.

6. The tank insulation attachment system shall be capable of being installed without requiring welding or other “hot work” so the tank can be insulated while remaining in service. The insulation system shall be designed and applied in accordance with the requirement of NFPA 22, and as recommended by the tank manufacturer.

3.2 INSPECTION AND TESTING

A. Welded steel water storage tanks shall be inspected and tested as follows:

1. The quality of field welding shall be determined by radiographs in accordance with the provisions of AWWA 100.
2. Liquid Tightness
   a. On completion of the welding of the tank bottom, each joint shall be vacuum tested to disclose porosity in the seams. Any deficiencies disclosed by the vacuum tested shall be corrected and retested to prove the bottom entirely watertight.
   b. Upon completion of tank erection and installation of all appurtenances, and prior to the application of any coating systems or insulation, the tank shall be tested for liquid tightness by filling to its overflow elevation for a 24-hour period. The erector shall correct any leaks disclosed by this testing in accordance with the manufacturer’s recommendations and the guidelines of AWWA D100. In the event that the correction of any leaks requires the tank to be drained and refilled, the cost of supplying and disposing of the additional water shall be borne by the contractor.
3. Coating System
   a. Verification of coating film thickness on tank surfaces shall be performed in strict accordance with AWWA D102. In areas where the total dry film thickness of the coating system is less than the minimum total dry film thickness specified for the coating system, additional coating shall be applied in order to attain the specified minimum dry film thickness for the coating system.
   b. Inside coating systems shall be tested in accordance with AWWA D102 with a wet-sponge, low-voltage holiday detector after the coating has cured in compliance with the manufacturer’s recommendations. Locations where holidays are detected shall be marked for repair and retested after repair work has been completed.
4. An authorized representative of the tank manufacturer shall perform all necessary field inspections and quality assurance checks. Following the successful completion of all inspections and testing required above, a written inspection report shall be submitted to the Engineer and the Owner. The report shall certify that the tank has been erected and tested in accordance with AWWA D100, AWWA D102, the manufacturer’s instructions and recommendations, and that any leaks have been repaired. The report shall include the following:
   a. A copy of welder performance qualifications
   b. A summary of inspection of radiographs, with copies of the radiographs and inspection records
   c. Identification of unacceptable radiographs and a statement of the action taken to rectify the unsatisfactory welds
   d. Record of welders employed on each joint, if applicable
   e. The erector’s or manufacturer’s records of welders
   f. A statement indicating the film thickness gauge used, the locations where tests were conducted, the dry film thickness at each location, and the name of the person conducting the tests.
   g. The test report shall be certified by a representative of the erector who witnessed the testing.

~END OF SECTION~

SECTION 22 0000
PLUMBING GENERAL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of the following sections:
1. Section 22 0000 - Plumbing General
2. Section 23 0000 - HVAC General
3. Section 26 0000 - Electrical General

1.02 STANDARDS

A. All Plumbing systems shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides.
1. 2018 North Carolina Plumbing Code with local Amendments.
2. 2018 North Carolina Building Code with local Amendments.
3. 2018 North Carolina Fuel Gas Code with local Amendments.
4. 2018 North Carolina Energy Conservation Code with local Amendments.
5. ANSI/NSF 61, NSF 372, and NSF 61-G compliance is required for all components of the domestic potable water system.
6. Americans with Disabilities Act (ADA)
7. American Society of Plumbing Engineers (ASPE) Data Books
8. National Fire Protection Association (NFPA) Standards:
   a. NFPA 54 - National Fuel Gas Code
9. Plumbing Drainage Institute (PDI)
10. Underwriters Laboratories Inc. (UL)
11. National Sanitation Foundation (NSF)
12. Local and State Fire Marshal requirements
13. Local Building and Inspection Department requirements
14. Local Health Department requirements
15. ASHRAE 90.1 – most current adopted edition.

B. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.03 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.04 WORK INCLUDED

A. Systems

1. The Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
   a. Domestic cold, hot and hot water recirculation systems
   b. Sanitary, drainage, waste and vent systems
   c. Natural gas system
   d. Primary and emergency storm drainage systems

1.05 DRAWINGS

A. The Drawings are diagrammatic and do not necessarily depict exact conditions. The indicated locations of equipment, ductwork, piping, etc. are approximate only. The Drawings are schematic in nature and are not to be scaled. Scales are shown for reference and approximation only. Refer to the architectural drawings for dimensional data of building components.

B. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Plumbing equipment. Manuals shall include copies of control schematics, sequences of operations, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists and instructions manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

B. The Contractor shall give detailed instructions for a period of not less than two (2) days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.

C. Prior to final acceptance by the Owner, the Contractor shall submit a complete as-built drawing submittal for the Engineer's review, three (3) sets of operating and maintenance manuals, spare parts lists, drawings, wiring diagrams, troubleshooting data,

manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.

D. A complete set of reproducible as-built drawings shall be provided indicating the location of all piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.

E. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

F. Provide all loose keys for supply valves, wall hydrants and hose bibbs installed.

G. Provide a full repair kit set (total relief valve kit, first check and second check kits) for each reduced pressure backflow preventer installed.

1.07 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size mylar and CD format.

1.08 EQUIPMENT, MATERIAL BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in Specifications or on Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.

C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction, capacities and performance. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

D. The Contractor shall coordinate the installation of all plumbing equipment proposed for use in this project with all building trades (architectural, structural, mechanical and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.09 START-UP-SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil

systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.10 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.

1. Plumbing fixtures, faucets and trim
2. Water heaters
3. Domestic water pressure booster system
4. Insulation
5. Floor drains and drainage accessories
6. Hydrants and hose bibbs
7. Mixing valves
8. Submersible pumps
9. Hot water return pumps
10. Backflow preventers
11. Pipe and fittings
12. Grooved joint couplings
13. Valves
14. Pipe supports
15. Piping accessories
16. Pipe labels and valve tags

B. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.

C. Quality Assurance/Control Submittals: Submit the following:

1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
2. Certificates: Submit the following:
    a. Manufacturer's certificate that products comply with specified requirements.
    b. Certificate indicating that the installer is authorized to install the manufacturer's products

D. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

E. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

F. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

G. Included with submittals of plumbing equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the plumbing and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the electrical contractor.

Plumbing Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

Electrical Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

H. Provide Material Safety Data Sheet (MSDS) or letter from manufacturer certifying the VOC content for each adhesive, sealant, paint and coating.

I. VOC Content: Submit adhesive and sealants product information or MSDS showing VOC Content information for all applicable products specified under this section. All applicable products in this section must meet low VOC content as specified by LEED Specification Section 01 8113 Sustainable Design Requirements.

1.11 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract

Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

1.12 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. 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.

F. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

G. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.02 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used for plumbing systems shall be as specified herein.

B. Motor controls, system controls, starters, disconnects, pilot lights, push buttons, etc. shall be furnished by the Contractor compatible with the apparatus that it operates. Electrical equipment shall be wired for the voltage, as shown on the Electrical Drawings.

C. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

D. Electric motors shall be high efficiency, open drip-proof type unless otherwise specified. Motors shall be standard NEMA continuous duty type and shall bear the UL Label. Motors shall be selected with a minimum of 15% safety factory greater than the fan brake/horsepower (e.g. 4.75BHP would require a nominal 7-1/2 HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall meet Table MG-1-12C of EPACT 1992.

E. Motors controlled by a variable frequency drive (VFD) shall be inverter duty rated and fully compatible with the VFD provided.

F. Starters for motors 1/3 HP and smaller shall be manual type, and for 1/2 HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

G. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein.

H. Motor controls shall be either “Hand-Off-Auto” switches or “On-Off” push buttons with one indicating light. “Hand-Off-Auto” switches shall be provided for automatically controlled apparatus.

I. Motor starters that are not an integral part of equipment shall be installed in conformance with Division 26 - Electrical Requirements.

J. All “loose” disconnects and starters shall be installed by Division 26.

K. Power wiring to disconnects, starters, and equipment shall be provided and installed by Division 26. All equipment requiring electrical power shall be provided with disconnect switches at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer’s recommendations and Electrical Drawings.

L. Provide all system controls and associated control and interlock wiring for complete and operable systems. 120 volt and higher wiring shall be MC cable or in conduit in accordance with local codes and the materials and installation requirements of Division 26 - Electrical.

M. All starters for 3-phase equipment shall have overload devices in all three (3) phases.

N. All starters and variable frequency drives shall be labeled on the face of the device with a semi-rigid plastic laminate nameplate with 1" high white letters on a black background securely affixed to the equipment. The label shall indicate equipment served (equipment tag used on the Drawings). Labels shall be furnished and installed by the Contractor.

O. Wiring diagrams shall be furnished by the Contractor.

P. Acceptable manufacturers shall be General Electric, Square D, Eaton, Siemens and Allen Bradley.

2.03 PIPING SYSTEMS

A. General
   1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on the Drawings.
   2. Piping, valves and equipment used in similar applications shall be provided from the same manufacturer unless noted otherwise.

B. Domestic Cold Water System, Underground, 3 Inches and Larger, Suitable for Working Pressure of 125 psig to 5'-0" Outside Building
   1. Piping Systems
      a. Basis of Design
         1) Ductile iron thickness Class 51 for 3 inch and 4 inch size thickness, Class 50 for 6 inches and larger, ANSI A21.51, ASTM A746 with bituminous coating outside and cement mortar lining inside. Ductile iron mechanical or push-on joints and fittings ANSI/AWWA C110/A21.10.
      b. Deductive Alternates

1) Mains where pressure is no greater than 100 psi: Polyvinyl Chloride (PVC), 160 psi water piping, ASTM D2241, SDR26 with mechanical or push-on joints with neoprene “O” rings, ASTM D3139.
2) Mains where pressure is greater than 100 psi: Polyvinyl chloride (PVC), 200 psi water piping, AWWA C900, 200 psi, with mechanical or push-on joints with neoprene “O” rings, ASTM D3139.

2. All valves, fittings, and changes in direction or elevation shall have joints restrained in accordance with NFPA-24.
3. Trenching Conditions: Class B1 bedding with 4" minimum thickness of clean granular fill. Recesses shall be provided at all pipe barrels to ensure no loads are transmitted at the joint connections.

C. Domestic Water System Branch Piping, Underground, 2 Inches and Smaller, Suitable for a Working Pressure of 125 psig
1. Piping Systems
a. Copper Type K, soft annealed, conforming to Federal Specification WWT-799. Joints and fittings are not permitted below floor slabs with copper Type K soft annealed pipe.
b. Multi-layer CPVC over aluminum composite middle layer bendable piping, ASTM D2846, solvent cement joints and fittings, ASTM F493. Noveon FlowGuard Gold Bendable.

D. Domestic Cold Water and Hot Water Systems Above Ground
1. Piping Systems
a. Basis of Design
1) Type “L” hard drawn copper tubing per ASTM B-88 and Federal Specification WWT-799. Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Fittings: Solder or brazed joint copper fittings per B16.18 or 16.22. Grooved copper fittings with full flow radius elbows; wrought copper to ASME B16.22 and ASTM B-75, or cast bronze to ASME B16.18 and ASTM B-584, Victaulic CTS system, or Engineer approved equal. Copper pressed fittings with radius elbows, crimped connections and EPDM O-rings, ASTM B-88, 200 psi rating, Ridgid Viega ProPress, ProPress XL or Elkhart Xpress systems. Ductile iron mechanical couplings with bolted connection for grooved piping, ASTM A-536, housings with offsetting angle-pattern bolt pads, with EPDM-HP copper tube size gaskets, rated working pressure 300 psi, installation-ready for direct stab installation without field disassembly. Basis of Design: Victaulic Style 607H. Joints: Soldered or brazed joints with lead-free brazing filler materials and compatible alloys.

Temperature	**Pipe Sizes**	**Type L Drawn Copper Tubing Permissible working pressures using NO LEAD SOLDERED FITTINGS (psi)**	**Type L Drawn Copper Tubing Permissible working pressures using PRESS FITTINGS (psi)**	**Type L Drawn Copper Tubing Permissible working pressures using ROLL GROVE FITTINGS (psi)**
100	½"-1"	1090	200	300
	1¼"-2"	850	200	300
	2½"- 4"	705	200	300

Temperature	Pipe Sizes	Type L Drawn Copper Tubing Permissible working pressures using NO LEAD SOLDERED FITTINGS (psi)	Type L Drawn Copper Tubing Permissible working pressures using PRESS FITTINGS (psi)	Type L Drawn Copper Tubing Permissible working pressures using ROLL GROVE FITTINGS (psi)
	5"-8"	660	N/A	300
	10"-12"	500	N/A	
150	½"-1"	625	200	300
	1¼"-2"	485	200	300
	2½"- 4"	405	200	300
	5"-8"	375	N/A	300
	10"-12"	285	N/A	
200	½"-1"	505	200	300
	1¼"-2"	395	200	300
	2½"- 4"	325	200	300
	5"-8"	305	N/A	300
	10"-12"	230	N/A	

b. Deductive Alternates

1) Hot and Cold Water Systems: Chlorinated Polyvinyl Chloride (CPVC) Schedule 40, ASTM F-441 and D-2846 (100 psi at 180 degrees F). Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Fittings: Schedule 40 socket type CPVC, ASTM F-439 and F-441. Joints: Solvent cement and primer for CPVC piping, ASTM F-493. All metal thread connections to fixtures and fittings (tub spout, showerhead, etc.) shall be connected with a brass transition fitting.

Temperature	Pipe Sizes	SDR 11 FlowGuard Gold CPVC Permissible working pressure (psi) ½"-2" (max size)	Schedule 80 Corzan (for Pipe Sizes greater 2") Permissible working pressure (psi)				
			2½"	3"	4"	6"	8"
73-80		400	420	370	320	280	250
100		325	344	303	262	229	205
120		260	273	240	208	182	162
140		200	210	185	160	140	125
160		160	168	148	128	112	100
180		100 (max. temp)	105	92	80	70	62
200			84 (max. temp)	74	64	56	50

E. Sanitary, Waste and Vent and Storm Drain Systems, Below Ground to 5'-0" Outside Building

1. Piping Systems

a. Basis of Design

1) Schedule 40 DWV PVC pipe, ASTM 1785. Install per ASTM D 2321. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM 2665. Joints: Solvent joints for PVC, ASTM D-2564. (PVC piping is not acceptable for waste piping receiving discharge higher than 130 degrees F, cast iron piping is to be installed at the central plant, mechanical rooms and at all laundry and kitchen equipment discharges.)

b. Alternate if required by Local Jurisdiction

1) Service weight hub and spigot cast iron soil pipe per ASTM A-74, coated on outside. Fittings: Service weight hub and spigot cast iron soil pipe fittings per ASTM-A-74, coated on outside. Joints: Neoprene gasketed joints per ASTM C564 and ASTM C 1563.

2) No-hub cast iron soil pipe per CISPI 301 and ASTM A888. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888. Joints: Cast iron mechanical couplings with neoprene gaskets and stainless steel nuts and bolts. Heavy duty type 304 stainless steel shielded couplings, ASTM C1540. Acceptable manufacturers: Husky SD 4000 or Clamp-All 125.

c. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.

d. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.

e. Foam core PVC piping is not acceptable for any drainage system.

f. All cast iron pipe and fittings shall carry an NSF International listing.

F. Sanitary, Waste and Vent Systems and Storm Drainage Systems Above Ground

1. Piping Systems

a. Basis of Design

1) Polyvinyl Chloride (PVC), schedule 40 DWV PVC pipe, ASTM D1785. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM D2665. Joints: Solvent joints for PVC, ASTM D2564. PVC piping is not acceptable in plenum ceilings or for waste piping receiving waste discharge higher than 130 degrees F, such as from laundry and kitchen equipment.

b. Alternate if required by Local Jurisdiction

1) No-hub cast iron soil pipe per CISPI 301 and ASTM A888. Fittings: No-hub cast iron fittings per CISPI 301 and ASTM A888. Joints: Joints for no-hub pipe and fittings shall be per CISPI 310, with stainless steel clamps and neoprene sleeve conforming to ASTM D 564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets on all sanitary, waste and storm drainage systems. Heavy duty couplings shall conform to the requirements of ASTM Standard C-1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure. Acceptable manufacturers: Husky SD 4000 or Clamp-All 125.

2) Type DWV copper tube per ASTM B-306 and ANSI H-23.6. Fittings: DWV solder joint fittings per ANSI B16.29 or B16.23. Joints: All solder joints shall be made with a solder consisting of 95% tin and 5% antimony.

3) Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.

4) Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.

5) All cast iron pipe and fittings shall carry an NSF International listing.

c. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.

d. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.

e. Foam core PVC piping is not acceptable for any drainage system.

f. All cast iron pipe and fittings shall carry an NSF International listing.

G. ProSet Fittings

1. Cast in place fire penetration sleeves such as ProSet and Holdrite Hydro Flame may be installed in lieu of block-outs and/or steel sleeves only in areas where the design ceiling clearances are maintained.
2. Code Red stack assemblies manufactured by ProSet Systems are not an acceptable fire stopping method for any system.

H. Pumped Discharge Piping

1. Piping Systems

a. Schedule 40 seamless or welded galvanized steel pipe, ASTM A-53. Fittings: Class 125 and 250, cast iron threaded fittings, ASTM A-126, ANSI B16.4. Ductile iron rigid grooved couplings, EPDM gasket, 316 stainless steel nuts and bolts. Victaulic Installation-Ready Style 177 (600 psi) or Style 77 (800 psi through 12").

b. Type “L” hard drawn copper tubing per ASTM B-88 and Federal Specification WWT-799. Fittings: Grooved end, solder or brazed joint copper fittings per B16.18 or 16.22. Victaulic Installation-Ready Style 607H (300 psi).

2.04 VALVES, FLANGES AND UNIONS

A. General

1. All systems under this section shall be provided with valves to permit complete and sectional control of the system. They shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified. Valves to comply with NSF 61-G, NSF 61, and NSF 372. Valves shall be as manufactured by one of the following companies: American, Anvil International, FNW, Kennedy, Kitz, Milwaukee, Nibco, Powell, Stockham, Victaulic, Watts, or approved equal, and shall conform to description listed below.
2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. <u>No</u> access panels will be permitted in public spaces with gypsum ceilings.

B. Valve Description

1. Gate Valves

a. 2-1/2" and larger, <u>Victaulic Series 771V</u> grooved ends (steel pipe), Stockham G-634, 175 lb. flanged OS&Y.

b. 2" and smaller, <u>Milwaukee UP149</u>, low lead, 125 lb., sweat connection. 2-1/2" and larger, Victaulic MasterSeal (steel pipe) and Series 608 (copper tubing); Milwaukee Fig. F-2885, 125 lb., flanged or Apollo 141WD-SE-1 lead free Butterfly valve with 10 pos. lever handle.

c. 8" and larger, Apollo141WD-SE-2 lead free Butterfly valve with gear operator.

d. 2-1/2" and smaller, Milwaukee BB-SC100, threaded.

2. Check Valves
   a. 2" and smaller, Milwaukee UP509, 200 lb., threaded, low lead.
   b. 2" and larger, Victaulic Series 716, grooved ends.
   c. 2-1/2" and larger, Milwaukee Fig. F-2974, 125 lb. flanged.
   d. 2-1/2" and larger, Stockham G-939, 175 lb. flange.
3. Ball Valves
   a. 2" and smaller, Milwaukee UPBA 100.
4. Plug Valves (Natural Gas System)
   a. 1/2" and larger, Rockwell Nordstrom Fig. 142 or 143 lubricated plug valve, threaded or flanged as required, wrench operated.
   b. 1/2" through 2", two-piece full port brass ball valve, FM and AGA approved, Watts series FBV-3 or equal.
5. Backflow Preventers
   a. Backflow preventers shall be installed at all locations required by code and local authorities, at all connections to mechanical equipment, and elsewhere as shown on the Drawings. Backflow preventers shall be reduced pressure principle type and shall be a complete assembly including tight-closing shutoff valves before and after the device. The design shall include test cocks and a pressure-differential relief seating check valves. The device shall meet the requirements of and be certified by ASSE Standard 1013, AWWA Standard C-506, NSF 61-G, NSF 61, NSF 372, and USC Foundation for Cross-Connection Control. A strainer shall be located upstream of the device. Route relief outlet from cone receptor to an air gap fitting for discharge to sanitary sewer.
   b. Acceptable manufacturers are Ames Company, Apollo Valves, Hersey Products, Watts Regulator, and Zurn-Wilkins.
6. Pressure Reducing Valves
   a. Pressure reducing valves, including by-pass and shock absorber, shall be provided on all domestic water systems greater where shown on the drawings.
7. Flanges
   a. All flanges shall be faced and drilled for not less than 125 pounds steam working pressure complete with necessary adapter, and shall be of size and material of adjacent piping. All flanges shall be faced (raised or flat) to be compatible with connecting valves, equipment, etc. The connection of one raised face flange to a flat face flange shall not be permitted.
8. Unions and Joints
   a. Unions on drainage pipes on fixture side of traps may be slip or flanged joints with soft rubber washers or gaskets. Unions 2" and smaller on copper pipe shall be all brass with ground joint and shall be 250# copper to copper. Unions above 2" shall be flanged with gaskets. Provide union at water and gas connection to all equipment, except plumbing fixtures.
      1) Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)

2.05 CLEANOUTS

A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
   1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers.

B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure 4530 or approved equal.

C. Brass cleanouts shall be solid nut construction.

D. Provide Owner with three (3) wrenches for removing flush cleanout plugs.

2.06 FLOOR DRAINS

A. Setting Grades
1. The plumbing contractor shall obtain exact elevation of finished grade at the top of the drains prior to setting any drains. Drains installed in excess of 1/4" below the adjacent finished floor shall be removed and reset to the correct elevation.

B. Drain Types
1. All floor drain outlets shall be of size noted on the Drawings. All drains shall be equal to the assembly specified. Acceptable manufacturers are as follows: Josam Co., Zurn Co., J.R. Smith Co., Wade, or approved equal. Drains shall be acid-resisting where indicated.
2. Floor drains noted as FD “G” for use in public spaces such as Restrooms, Locker Rooms, Showers, etc., shall be general purpose type. Drains shall be cast iron with 6" square nickel bronze strainer and trap primer connection. Drains shall be Jay R. Smith Figure 2005B-L-B6-P050 or approved equal.
3. Floor drains noted as FD “M” for use in mechanical rooms shall be heavy duty type. Drains shall be cast iron shallow type, 12" diameter with ductile iron tractor grate, sediment bucket, and trap primer connection. Secured funnels shall be provided on all drains receiving condensate discharge to eliminate overflow or spillage. Drains shall be Jay R. Smith Figure 2142 series or approved equal. Drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
4. Floor sinks noted as “FS” shall be cast iron with acid resistant coating, 12" square x 8" deep, aluminum or cast iron dome bottom strainer (plastic strainers are not acceptable), nickel bronze half or three-quarter grate as required by the equipment served. The solid portion of the grate shall be located to the front of the equipment; the open section of the grate shall be located at the rear of the equipment for receipt of the indirect waste. Floor sinks shall be Jay R. Smith figure 3430 series.
5. Floor or hub drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
6. Unless otherwise noted, acceptable manufacturers shall be Josam, Jay R. Smith, Mifab, Watts, and Zurn.

C. Trap Primers
1. Drains not receiving a continuous discharge are to be provided with an automatic trap primer.
2. Trap primers shall be in-line type actuated by flow independent of pressure, pressure activated primers are not acceptable. PPP Prime-Pro Series.

D. Roof Drains
1. 6” and smaller: Roof drains labeled “RD” installed in steel construction or built-up roof shall have a cast iron body with combined flashing and gravel stop, underdeck clamp and sump receiver, adjustable extension as required and cast iron dome. Jay R. Smith 1015-R-C or approved equal.
2. 8” and larger: Roof drains labeled “RD” installed in steel construction or built-up roof shall be high capacity with 216 sq. in. free area, have a cast iron body with combined flashing and gravel stop, underdeck clamp and sump receiver,

adjustable extension as required and cast iron dome. Zurn Model Z101 or approved equal.

3. 6” and smaller: Emergency roof drains labeled “ERD” shall be have a cast iron body, combined flashing and gravel stop, cast-iron dome, 3" minimum internal water dam, under deck clamp, sump receiver and extension as required. Jay R. Smith 1070-C-R or approved equal.
4. 8” and larger: Emergency roof drains labeled “ERD” shall be high capacity with 216 sq. in. free area, have a cast iron body, combined flashing and gravel stop, cast-iron dome, 3" minimum internal water dam, under deck clamp, sump receiver and extension as required. Zurn Model Z101 or approved equal.
5. Unless otherwise noted, acceptable manufacturers shall be Josam, Sioux Chief, J.R. Smith, Mifab, Watts, and Zurn.

2.07 ACCESS PANELS

A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.

B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.

C. Panels shall have flush doors with No.14 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

D. Access panels are not allowed in gypsum ceilings in public spaces.

2.08 INSULATION

A. The following shall be insulated:
1. All domestic cold water piping above grade.
2. All hot water and hot water return piping.
3. All horizontal storm drain piping and roof drain bodies.
4. All hot and cold water piping exposed to areas subject to freezing, refer to “Heat Cable for Freeze Protection of Piping” under Part 2 of Section 22 0000 for additional requirements.

B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with 4 lb. density sectional fiberglass insulation with a thermal conductivity not to exceed 0.24 with white all service jacket and vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “All Service Jacket” three-inch wide tape.

C. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab.

D. Materials as specified in this section shall be manufactured by CertainTeed, Johns Manville, Knauf, Owens Corning or equal. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes				
Piping System Types	Fluid Temperature Range		1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	°F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	–
Domestic Hot Water and Hot Water Recirculation	43-71	110-160	1.0	1.5	1.5	1.5	–
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	–
Horizontal Storm Drainage	Ambient	Ambient	–	–	1.0	1.0	1.0

2.09 PIPE SUPPORTS AND HANGERS

A. All piping shall be supported by means of hanger rods and pipe hangers from roof or floor structure using supplementary steel and/or lagbolts. Water supply pipe connecting to pumps, equipment, fixtures or fixture supplies shall be made rigid at the connection point.
   1. Piping shall be supported from new concrete construction with Anvil International Fig. 282 inserts or drilled expansion anchors.
   2. Piping shall be supported from new steel construction with Anvil International Fig. 131 beam clamp, Fig. 61 beam clamp, Fig. 66 welded beam attachment or Fig. 60 washer plate with all-thread rod.
   3. Piping and brackets shall be supported from hollow block construction using drilled masonry holes and cadmium plated toggle bolts.
   4. Piping shall be supported from wood truss construction with plated lag screws or bolts, B-3227 and B-3228.
   5. Pipe supports shall not be attached to floor or roof deck.
   6. Acceptable manufacturers are: Anvil, B-Line and FNW.

B. All hangers supporting rain leaders shall be concentrically placed on supporting structure. See structural drawings.

C. Unless otherwise noted, hangers and clamps shall be as listed below (all model numbers are B-Line Systems):
   1. Cast iron/steel pipe - B3100 or B3109.
   2. Insulated water pipe - B3100 or B3109 with B3151 placed over insulation protection saddle.
   3. Uninsulated bare copper pipe - B3170 CTC plastic coated.
   4. All supports and mounting hardware are to be galvanized, cadmium plated, or factory enamel painted.
   5. All supports on insulated piping systems shall be sized to fit outside the insulation and shall be provided with insulation inserts and shields at each hanger or support point.

D. Branch piping to fixtures in chases shall be supported with plastic or copper clamp type supports:
   1. B-Line Ruffin series.
   2. Holdrite Systems.

E. Maximum spacing between pipe hangers shall be:
   1. Steel pipe
      a. 1-1/4" and smaller: 6'-0"
      b. 1-1/2" – 2": 8'-0"
      c. 2-1/2" and larger: 10'-0"

2. Cast iron soil pipe: 2" and larger: 10'-0"
3. Copper tubing:
    a. 1/2" – 1-1/4": 5'-0"
    b. 1-1/2" – 2": 8'-0"
    c. 2-1/2" and larger: 10'-0"
4. PVC/CPVC and all plastic pipe:
    a. 1-1/4" and smaller: 3'-0"
    b. 1-1/2" and larger: 4'-0"

F. At least one hanger shall occur within 2'-0" from where change in direction takes place. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support vertical risers. Vertical piping drops shall be rigidly anchored to structure at the top and bottom offsets and at eight foot increments along the vertical drop.

G. Special approved hangers that require less installation space are to be used where required due to ceiling space limitations.

H. All connections to pumps and other vibrating machinery shall be provided with stainless steel braided flexible hose connections. Connections to potable water systems shall meet ANSI/NSF 61 design standards.

I. Provide longitudinal and transverse bracing on the domestic water loop where indicated on the drawings. Provide additional bracing at each 1-1/2" or larger tap connection and where loop piping has 90 degree turn.

2.10 WATER HEATERS – ELECTRIC

A. Provide electric storage type water heaters as specified on the Drawings.

B. Water heater shall carry a UL certification for 150 psi working pressure, an ASME temperature and pressure relief valve (T and P) sized for the heater, vacuum relief valve, immersion thermostat, glass lined tank, temperature gauge on outlet, and manual reset high limit control.

C. Provide a metal drain pan and 3" high concrete housekeeping pad at each water heater. Water heaters greater than 10 gallons shall be floor mounted.

D. Provide an expansion tank or combination ball/relief valve on the domestic water supply sized as indicated on the Drawings. Combination ball/relief valve shall be Watts series LFBRV or approved equal.

E. Water heaters that are not supplied with integral heat traps and serving non-circulating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment. A check valve and expansion tank can be utilized in lieu of the supply side heat trap.

F. The water heater shall carry a five-year minimum limited warranty for tank leakage.

G. Electric water heaters shall be as manufactured by:
1. A.O. Smith
2. Bradford White
3. Lochinvar
4. State

2.11 FLASHING

A. Vent pipes passing through roof shall be flashed watertight.

B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.12 FLOOR, WALL AND CEILING PLATES

A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.13 GALVANIC PROTECTION

A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings.

2.14 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
   1. Domestic hot, cold and hot water recirculation water piping
   2. Gas piping
   3. Primary and emergency storm drainage piping
   4. Sanitary, waste and vent piping

B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

C. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.

D. Each valve in the Plumbing system is to be provided with an individually numbered valve tag.

E. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.

F. Valve tags will include a “P” lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of the Plumbing system.

G. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

H. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.15 EQUIPMENT LABELING

A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.

B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
   1. Permanently attached plastic laminate signs with 1" high lettering.
   2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.02 EXCAVATION, TRENCHING AND BACKFILLING

A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.

B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer’s installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.

D. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.

E. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.03 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.

C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.04 CUTTING AND PATCHING

A. Work shall include all cutting, patching, masonry and carpentry required as part of the equipment installation when not provided by other sections of these specifications.

B. All work shall be performed as specified under architectural specification section for cutting and patching.

3.05 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for equipment where required.

B. Provide 3" thick housekeeping pads at floor mounted equipment a minimum of 3" larger than the entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.06 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, etc. shall be thoroughly cleaned both inside and out.

C. After testing and balancing of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

3.07 PAINTING

A. Painting, except as otherwise specified, will be done under another section of the specifications, but the Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The Contractor shall touch-up to match original finish any equipment scratched in shipment or installation. Touch-up painting of plumbing equipment shall be part of the plumbing work.

C. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces which are not galvanized (this includes piping systems). Rust preventative painting shall be part of the plumbing work.

D. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these specifications. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.08 EQUIPMENT SUPPORT

A. Major equipment supports (framed structural openings, etc.) shall be furnished and installed by others as shown on the Drawings. The plumbing work shall include, the furnishings and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all equipment.

B. Unless otherwise shown on the Drawings, all equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural joists shall be supported by the top chord only of such joists. Hangers shall not be attached to the bottom chord of any joists.

3.09 PIPE PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe penetrations. Sleeves for pipe shall be Schedule 40 black steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe.

B. The 1/4" minimum clearance shall be provided between the sleeve and the insulation on insulated piping systems. A gap of the insulation shall be omitted at each side of a rated wall penetration to allow for the required fire stopping.

C. As far as possible, all pipe penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

D. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

E. Pipe penetrations through exterior walls shall be sealed watertight with expandable link type seals by Thunderline, Linkseal or Engineer approved equal.

F. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, or approved equal.

3.10 FLASHING

A. All piping penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in other sections of these specifications.

B. Flashing for piping shall be sheet lead of not less than 6 pounds per square foot, shall have a base not less than 2 square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

3.11 PIPING SYSTEMS

A. Water Piping - General

1. Pipe used in piping assembly must be clean of dirt and obstructions and shall have ends square and reamed before putting into the fittings.

2. All piping must be true and plumb with proper pitch for draining of the soldering.
3. All domestic water lines serving flush valve fixtures and washing machines shall be protected from water hammer by shock absorbers. Where shock absorbers are required they shall be as manufactured by Josam Mfg. Company, J. R. Smith, Sioux Chief Ind., Precision Plumbing or Zurn Mfg. Co. and shall conform to the Plumbing and Drainage Institute published requirements.
4. All connections to water heaters, tanks and equipment shall be made with unions or flanges. Insulated piping systems shall be installed to provide space for insulation.
5. Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)
6. When installing CPVC for all Potable and Non Potable systems Contractor shall have received installation training from either the pipe/fitting manufacturer or designated representative before the project starts and shall furnish a copy of the "training documentation" within the project submittal for each installing individual showing current installation training.
7. When installing Pex piping for all Potable and Non Potable systems Contractor shall have received installation training from either the pipe/fitting manufacturer or designated representative before the project starts and shall furnish a copy of the "training documentation" within the project submittal for each installing individual showing current installation training.

B. Sanitary Waste, Vent, Indirect Waste and Storm Drain Piping - General
1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/4 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible. Where long runs of piping require less pitch due to space restrictions, a less pitch shall be allowed on main lines four (4) inches and over in size, but in no event should any pipeline have a slope less than 1/8 inch per foot.
2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the Drawings.
3. Main vent stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least three (3) feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45 degree fittings wherever possible. Horizontal vent lines shall pitch toward the waste line.
4. Threaded joints shall have American National taper screw thread with graphite and oil compound applied to the male threads.
5. Sanitary and vent stacks are to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.

C. Mounting heights, unless otherwise noted, are to the centerline of the equipment and/or device.

3.12 TESTING OF PIPING SYSTEMS

A. General
1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the

time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.

2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with a minimum 48-hour notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Sanitary Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Interior Water Piping Systems

1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.

D. Exterior Water Piping System

1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.

E. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

F. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.13 DISINFECTION OF WATER SYSTEM – INTERIOR AND EXTERIOR

A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.

B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hydrochloride solution and shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be

opened and closed several times. After disinfection, the solution shall be flushed from the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.

C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

3.14 FIXTURE CONNECTIONS AND SUPPORTS

A. Wall fixtures shall be hung by means of carrier type fixture supports as manufactured by J.R. Smith, Josam, Mifab, Wade or Zurn.

3.15 SLEEVES

A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.16 INSTALLATION OF UNIONS

A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.17 TRAPS

A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.18 CLEANOUT INSTALLATION

A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

3.19 FLASHING INSTALLATION

A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.

B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

3.20 EQUIPMENT AND MATERIAL PROTECTION

A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.21 SPACE REQUIREMENTS

A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the

building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF SECTION

SECTION 22 1123
DOMESTIC WATER PRESSURE BOOSTER SYSTEM

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

General Conditions: Refer to the General Conditions, the **Supplementary** General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

A. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All work shall be accomplished by workmen skilled in the various trades involved.

B. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.02 STANDARDS

A. The domestic water pressure booster system shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:
   1. 2018 North Carolina Plumbing Code with local Amendments.
   2. 2018 North Carolina Building Code with local Amendments.
   3. UL Listing - All motors, controllers and electrical components shall carry a UL Approval for the assembly.
   4. NEMA Compliance - All controllers shall be designed in accordance with the specified NEMA requirements.
   5. ANSI/NSF 61 compliance is required for all components of the domestic water system.

1.03 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.04 DRAWINGS

A. The Drawings are diagrammatic and do not necessarily depict exact conditions. The indicated locations of equipment, ductwork, piping, etc. are approximate only. The Drawings are schematic in nature and are not to be scaled. Scales are shown for reference and approximation only. Refer to the architectural drawings for dimensional data of building components.

B. The locations, arrangement and extent of equipment, devices, conduit, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale Drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete

and properly operating installation.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Plumbing equipment. Manuals shall include copies of control schematics, sequences of operations, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists and instructions manual for each piece of equipment. Upon approval, one (1) copy shall be delivered to the Owner; one (1) copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

B. The Contractor shall give detailed instructions for a period of not less than one (1) day to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.

C. Prior to final acceptance by the Owner, the Contractor shall submit a complete as-built drawing submittal for the Engineer's review, three (3) sets of operating and maintenance manuals, spare parts lists, drawings, wiring diagrams, troubleshooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.

D. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

1.06 EQUIPMENT, MATERIAL BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.

C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

D. The Contractor shall coordinate the installation of all equipment proposed for use in this project with all building trades (architectural, structural, and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.07 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' shop drawings for the domestic water pressure booster system prior to ordering, purchasing, or installation. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.

B. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of shop drawings by the Engineer does not relieve the Contractor from the responsibility of complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc. Such coordination shall be clearly indicated on the shop drawings.

D. All shop drawings shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

E. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

F. Included with shop drawings of mechanical equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the mechanical and electrical contractors. A photocopied reproduction of the below statement is acceptable.

G. Submittal shall include pump curves with selection point clearly identified and wiring diagrams for all electrical components.

1.08 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.01 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

A. Furnish and install a factory fabricated vertical or horizontal mounted duplex pressure booster system. The system shall be capable of the capacity and flow rate as indicated on the Drawings.

B. Close-Coupled Pumps
   1. Pumps shall be variable speed horizontal or vertical multi-stage equipped with stainless steel shaft and impeller and sleeve mounted mechanical shaft seal.
   2. Each close-coupled pump motor shall be TEFC and of the energy efficient type and shall meet NEMA standards and operate within the available service factor at any point on the pump capacity head curve.
   3. All pumps shall be provided with VFD drives.

C. Factory Fabrication
   1. The system shall be factory fabricated complete with isolation valves on the suction and

discharge of each pump. Suction and discharge manifolds are to be Type L copper or schedule 40 stainless steel. The pump assembly shall be provided with anti-vibration pads as specified below. The only field connections required will be to system headers, tank (if required), over temperature drain tube, and one incoming power connection at the control panel.

2. Provide stainless steel double sphere floating flange flexible vibration isolator complete with stainless steel control rod assemblies on the suction and discharge headers; Kinetics Kinflex FTC series or Engineer approved equal.
3. Provide base mount free-standing unhoused spring vibration isolators with 1/4" minimum neoprene noise isolation pads, Kinetics FDS series or Engineer approved equal.

D. Factory Test and Certification
1. The booster system and its component parts shall undergo a complete operating flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. The system shall carry an ETL certification of testing.

E. Start-Up-Service
1. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of the booster pump assembly. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

F. Acceptable manufacturers in compliance with the specified requirements:
1. Delta P Systems
2. Flo-Pak
3. Grundfos BoosterpaQ
4. VC Systems/Peerless Pumps
5. Syncroflo, Inc.
6. Quantum-Flo
7. Carver

2.02 POWER AND CONTROL PANEL

A. Assembly shall include a NEMA 12 power and control panel complete with three through the door disconnect switches, circuit breakers, magnetic starters each with 3 leg overload protection, fused control circuit transformer, automatic 24-hour alternation, low suction shutdown with visual alarm light and auxiliary contact, pump indicating lights, multiple position selector switches, control power light, low system indicating light, and lag pump start time delays. All of the above shall be factory internally pre-wired and tested in accordance with provisions of the National Electric Code. All control wires shall be individually numbered and each component shall be labeled accordingly. All internal wiring shall be copper stranded,

A.W.G. with a minimum insulation of 90 degrees C. The complete assembly shall have the UL Listing mark for industrial control panels.

B. Instrumentation and Emergency Controls
1. Each system shall have panel mounted pressure gauges for indicating suction and system discharge pressure. A pre-wired and pre-piped temperature probe shall be installed in each pump and connected to a common electric purge valve for over temperature protection of pumps alarm horn with silence circuit, high system alarm with time delay, high suction shutdown with time delay, low level alarm light.

2.03 ELECTRICAL WORK

A. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

B. Electric motors shall be NEMA Premium Efficiency open drip proof type. Motors shall meet NEMA MG1 Table 12-12 of EISA, 2010. Motors shall be selected with a minimum of 15% safety

factor greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7½ HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection.

C. Motors controlled by a variable frequency drive (VFD) shall be inverter duty motors designed according to the requirements of NEMA MG 1, Part 31, "Definite Purpose, Inverter Fed Motors" and shall be compatible with the particular manufacturer's drive that is used.
   1. Shaft Grounding Rings - All motors controlled by variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge damaging shaft voltages away from the bearings to ground.
      a. Motors up to 100HP shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.
      b. Shaft grounding rings shall be AEGIS bearing protection ring by Electro Static Technology-ITW.
   2. High Frequency Grounding Straps - All motors controlled by variable frequency drives shall be bonded from the motor foot to the system ground with a high frequency ground strap fabricated of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection.
      a. Proper grounding of motor frame for all inverter-driven induction motors shall be in accordance with ABB Technical Guide No.5 and Allen Bradley Publication 1770-4.1 Application Data Industrial Automation Wiring and Grounding Guidelines
      b. High frequency bonding strap shall be AEGIS high frequency ground strap by Electro Static Technology-ITW.

2.04 VARIABLE FREQUENCY DRIVES (Panel Mount)

A. The VFD shall convert incoming fixed frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFDs utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

B. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

C. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.

D. The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VFDs that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.

E. VFD shall automatically boost power factor at lower speeds.

F. The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.

G. An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation.

H. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

I. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

J. The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

K. VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to -15% of the rated input voltage.

L. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. VFDs without a DC link reactor shall provide a 5% impedance line side reactor.

M. VFD to be provided with the following protective features:
   1. VFD shall have input surge protection utilizing MOVs, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.
   2. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
   3. VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
   4. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.
   5. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.
   6. The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.

N. FD to be provided with the following interface features:
   1. VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
   2. VFD shall display all faults in plain text; VFDs, which can display only fault codes, are not acceptable.
   3. All VFDs shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
   4. VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.
   5. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
   6. A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
   7. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLCs and other connected equipment from power surges and spikes.
   8. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
   9. There shall be three programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. An additional digital input is preprogrammed

for start/stop.

10. The VFD shall have two analog signal inputs. One dedicated for sensor input and one for external set point input.
11. One programmable analog output shall be provided for indication of a drive status.
12. The VFD shall provide two user programmable relays with selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
13. The VFD shall store in memory the last 5 faults with time stamp and recorded data.
14. The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.

O. VFD service conditions:
1. Ambient temperature operating range: 14 to 113ºF (-10 to 45ºC)
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 3,300 feet (1000 meters) without derating.
4. VFDs shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -15% variations. Line frequency variation of ± 2% shall be acceptable.
5. No side clearance shall be required for cooling of the units.

PART 3 - EXECUTION - Not Used

END OF SECTION

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SECTION 22 1600
NATURAL GAS PIPING SYSTEM

PART 1 – GENERAL

1.01 SYSTEM

A. Provide a complete system of natural gas piping from gas meter to all natural gas burning equipment and appliances.

B. All gas equipment specified herein shall be suitable for use with natural gas system.

1.02 DESIGN STANDARDS

A. The natural gas system shall be designed and installed in accordance with the requirements of the following codes and standards:
   1. 2018 North Carolina Fuel Gas Code with Local Amendments.
   2. NFPA 54 - National Fuel Gas Code

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

A. Underground Piping
   1. Schedule 40 black steel pipe, ASTM A53 with polyethylene jacket, welded joints and standard weight black steel butt weld or socket weld fittings, ASTM A243.
   2. Polyethylene pipe, ASTM 2513, with heat fusion joints and fittings, ASTM D2513.

B. Aboveground Piping
   1. Schedule 40 black steel pipe, ASTM A53 with welded joints and standard weight black steel butt weld fittings, ASTM A234 or socket weld fittings, ASTM A105, for all piping concealed in walls or above ceiling, ALL medium pressure piping and all piping 2.5 inch or larger.
   2. Schedule 40 black steel pipe, ASTM A53, with 150 pound steel slip-on welding flanges, ASTM A181, for connection to flanged valves and equipment.
   3. Schedule 40 black steel pipe, ASTM A53, with screwed joints and 150 pound threaded malleable iron fittings, ASME B.16.3, for low pressure piping 2 inch or smaller.
   4. No press fittings are allowed on natural gas piping.

2.02 JOINTS

A. Threaded joints shall be made with a pipe compound specifically listed as resistant to reaction with liquefied petroleum gas and shall be applied to male threads only. After cutting and prior to threading, pipe shall be reamed and shall have burrs removed.

B. Welded joints shall be fusion welded in accordance with the American Standards Code for pressure pipe, ASME B31.1, Section 6.

C. Flanged joints shall be faced true, provided with ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges of valves.

2.03 UNIONS

A. Unions in steel piping shall be 150 pound socket welded carbon steel conforming to ASME B.16.11 or class 150 malleable iron threaded fittings conforming to ASME B.16.3.

2.04 VALVES

A. Valves 3" in size and larger shall be semi-steel plug valves with cast iron body, lubricated cast iron plug, flanged ends, and wrench operated for 175 pound WOG. Valve shall be Rockwell Nordstrom Fig. 143 or equal.

B. Valves 2-1/2" in size and smaller shall have bronze body and plug, socket welded ends, and square head for 125 WOG. Valve shall be Crane or Fig. 250 or equal.

C. Full port ball valves 2" in size and smaller shall have brass body with chrome plated brass ball with threaded or socket welded ends, 600 psi WOG, FM approval, AGA approval. Valve shall be Watts series FBV-3 or equal.

D. Lubricated plug valves shall be lubricated at the factory and sealant shall be suitable for natural gas. Provide two valve wrenches for each type of valve specified.

E. Acceptable valve manufacturers are Rockwell Nordstrom, Crane, FNW, Stockham, Powell, Walworth, or Milwaukee.

2.05 PRESSURE REGULATING VALVES

A. Pressure regulator shall be cast iron, ductile iron or stainless steel, corrosion-resistant spring-loaded type with internal pressure relief, 175 psi working pressure. Provide threaded ends for piping 2" and smaller, flanged ends for piping 2-1/2" and larger. All regulator vents shall be extended to the exterior unless otherwise specified. Regulators equipped with and labeled for use with an approved vent-limiting device shall not require a vent to the exterior. Acceptable manufacturers are Fischer Regulators, Jordan Valve, Maxitrol, Rockwell and Sensus.

B. Low pressure regulators supplied from medium and high pressure gas systems shall be lock-up type high gas pressure regulators and shall be installed a minimum of ten feet upstream of the equipment inlet connection.

C. Where low pressure line regulators have inlet pressures exceeding 2 psi, a downstream over-pressure protection device (OPD) shall be installed in accordance with ANSI Z21.80.

D. Medium pressure regulators shall have a capped tee fitting (sediment trap) upstream from the regulator and a capped tee fitting installed not less than 10 pipe diameters downstream of the regulator.

2.06 PROTECTIVE COATING

A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using “Scotchwrap,” “CT Tapecoat” or “X-Tru-Tape.” Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.07 CATHODIC PROTECTION

A. All underground gas piping shall be cathodically protected. Provide a minimum of two 17-pound magnesium anodes containing 6% aluminum and 3% zinc alloy. Anodes shall be distributed equally along the pipe run, but spacing shall not exceed 100 feet between anodes. Each anode shall be attached to the pipe by the Caldwell or brazing process. The connecting wire shall be buried in backfill composed of 75% gypsum, 20% bentonite and 5% sodium sulphate. Wherever the underground gas piping rises above grade, provide an insulating dielectric fitting.

2.08 PIPE SUPPORTS & HANGERS

A. All piping shall be supported by means of hanger rods and pipe hangers from roof or floor construction using supplementary steel and/or lagbolts.
   1. Piping shall be supported from new steel construction with Anvil International Fig. 131 beam clamp, Fig. 61 beam clamp, Fig. 66 welded beam attachment or Fig. 60 washer plate with all-thread rod.
   2. Piping and brackets shall be supported from hollow block construction using masonry drilled holes and toggle bolts.
   3. Piping shall be supported from wood truss construction with plated lag screws or bolts, B-3227 and B-3228.

B. Unless otherwise noted, hangers and clamps shall be as listed below (all model numbers noted are B-Line Systems):
   1. Gas pipe – B3100 or B3109.
   2. All supports and mounting hardware are to be galvanized or cadmium plated.

C. Maximum spacing between pipe hangers shall be:
   1. 1/2": 6'-0"
   2. 3/4"-1": 8'-0"
   3. 1-1/4" and larger: 10'-0"

D. At least one hanger shall occur within two feet (2'-0") from where a change in direction takes place in the line. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support pipe. Equal manufacturers for hangers and clamps are B-Line Systems, Anvil International, Fee and Mason, PHD Manufacturing, or approved equal.

E. Piping on roofs shall be limited to branch piping to each piece of equipment and supported every six feet on piping 1/2" size, eight feet on piping 3/4" – 1" size, and ten feet on piping 1-1/4" and larger, and at each change in direction, with pipe stands secured to the roof per the roofing manufacturer's installation requirements. Pipe stands shall be DURA-BLOK DB10 or approved equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All interior gas systems shall be bonded to the building's grounding system per the requirements of NEC Section 250. A written statement bearing the names and signatures of the plumbing and electrical contractors indicating compliance with the NEC grounding requirements is to be submitted prior to project close-out.

B. A valved union shall be provided at each connection to a piece of equipment. Equipment provided with a flanged inlet shall have a flanged connection.

C. All valves installed in horizontal lines shall be installed with the stems horizontal or above.

D. All gas piping shall be graded at the maximum slope available to prevent traps. All horizontal lines shall slope to risers and from the risers to the meter or appliance.

E. Drip legs, 6" long, shall be provided in gas piping at ends of horizontal runs, at the base of risers, and at connections to equipment.

F. Provide pressure regulators at all required connections to equipment; regulators shall be provided at the pressure required by the equipment served. Extend all pressure regulator vents individually to the exterior per local code authority requirements.

G. Branch piping shall be taken off the top or sides of horizontal lines, but not from the bottom.

H. Changes in pipe size shall be made with reducing fittings. No bushings will be allowed.

I. No gas piping shall be placed underground inside the building.

J. Main gas piping shall be installed inside the building and routed within the joist space.

K. All interior and exterior ferrous metal gas piping, fittings and supports shall be primed and painted with two (2) coats of exterior grade enamel paint. The paint color shall be Safety Yellow.

L. Underground Piping
   1. General:
      a. Lay, align, anchor and test pipe and make-up joints. Perform excavating, cleaning, laying, jointing and backfilling as concurrently as possible to maintain uniform installation. Replace or repair damaged materials to condition equal to new material.
   2. Excavation and Backfilling:
      a. Care shall be taken not to excavate below depth necessary.
      b. Do not leave unjointed piping in trench overnight. Backfill trenches by filling and tamping in not more than 6" layers after pipes, tanks, or other structures have been installed, tested and approved.
   3. Pipe Crossing:
      a. Lay lower pipe, backfill with crushed stone, gravel or concrete as directed and thoroughly compact to level of upper pipe.

3.02 TESTING

A. All piping is to be inspected and purged per the requirements of NFPA 54 and the local authorities' requirements.

B. The entire gas piping system shall be tested with compressed air to 100 psi for a period of two (2) hours.

C. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 22 0000 - Plumbing General.

1.02 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install the plumbing fixtures, trim and supports, complete as indicated on the Drawings and as specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

A. All fixtures shall be white, unless otherwise indicated.

B. All water closets shall have fully glazed trapways.

C. All exposed trim to be heavy polished chrome plated brass, unless otherwise indicated. Chrome plated escutcheons are to be provided on all exposed fixture supplies and waste lines, including lavatory vanities.

D. Electric water coolers shall be ARI Certified and shall carry a UL Listing. Units shall use refrigerant which is approved for use without ozone depleting properties. All waterway components are to be certified as lead free.

E. All sinks and lavatories for use by the handicapped shall have manufactured insulation shields on all supplies and P-traps per ADA requirements unless the vanities are provided with ADA compliant shrouds.

F. All exposed plumbing fixture items such as faucets and flush valves shall be provided with vandalproof trim.

2.02 CLEANOUTS

A. Cleanouts on exposed piping in unfinished areas shall be heavy duty cast iron with countersunk plug. Cleanouts shall be Jay R. Smith Figure 4220 or approved equal.

B. Cleanouts installed behind walls in finished areas shall be cast iron ferrule type for no-hub or service weight pipe with nickel bronze round frame and cover with securing screws. Cleanouts shall be Jay R. Smith Figure 4472T or approved equal.

C. Cleanouts installed in concrete floors shall be cast iron type with gasket seal ABS plug round adjustable ductile iron cover with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4231L-M or approved equal.

D. Cleanouts installed in tile floors shall be cast iron type with gasket seal ABS plug for easy removal, adjustable round nickel bronze top recessed for tile with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4151L or approved equal.

E. Cleanouts installed in carpeted areas shall be cast iron type with gasket seal ABS plug, nickel bronze round frame and cover with carpet marker. Cleanouts shall be Jay R. Smith 4031-Y or approved equal.

2.03 PLUMBING FIXTURES

A. The following is a list of acceptable manufacturers for the project:
1. Fixtures: American Standard, Kohler, Toto and Zurn
2. Faucets: American Standard, Chicago Faucets, Kohler, Moen, Speakman, Symmons, Zurn and Toto
3. Stainless Steel Sinks: Elkay, Just, Kohler
4. Trim: American Standard, Brasscraft, Kohler, McGuire and Zurn
5. Drains, Carriers and Hydrants: Josam, Mifab, Prier, Jay R. Smith, Wade and Zurn
6. Carriers: Jay R. Smith, Zurn and Josam

B. Plumbing fixtures shall be as scheduled below.

PLUMBING FIXTURE SCHEDULE

Fixture	Description	Acceptable Manufacturers	
WC-1	WATER CLOSET – PUBLIC – SENSOR: Wall hung, 1.28-gallon flush valve, vitreous china, elongated, siphon jet, 1-1/2" top spud, bolt caps, white.	American Standard 3351.128	Kohler K-4325
	SEAT: Commercial grade, solid plastic, elongated, open front, stainless steel check hinge, white.	Beneke 523-SS	Church 295NSSC
	FLUSH VALVE: 1.28-gallon flush, sensor operated, solenoid operator, externally adjustable, 1-1/2" top spud coupling, wall and spud flanges, vandalproof trim, chrome plated.	Zurn ZER6000PL-HET-CPM	Sloan G2 Optima Plus 8111-1.28
	CARRIER: Adjustable, horizontal and vertical series.	Smith 210 Series	Zurn 1203/1204 Series
WC-1H	WATER CLOSET – PUBLIC – HANDICAPPED – SENSOR: Wall hung, 1.28-gallon flush valve, vitreous china, elongated, siphon jet, 1-1/2" top spud, bolt caps, white. Fixture to be installed with top of seat at 18" above finished floor.	American Standard 3351.128	Kohler K-4325
	SEAT: Commercial grade solid plastic, elongated, open front, stainless steel check hinge, white.	Beneke 523-SS	Church 295NSSC
	FLUSH VALVE: 1.28-gallon flush, sensor operated, battery powered, externally adjustable, 1-1/2" top spud coupling, wall and spud flanges, vandalproof trim, chrome plated, ADA compliant.	Zurn ZER6000PL-HET-CPM	Sloan G2 Optima Plus 8111-1.28 (Rough-in to be lowered to 10" per manufacturer's ADA installation requirements)

	CARRIER: Adjustable, horizontal and vertical series.	Smith 210 Series	Zurn 1203/1204 Series
WC-2	WATER CLOSET – PUBLIC – HANDICAPPED: Floor mount, 1.28-gallon flush valve, vitreous china, elongated, siphon jet, 1-1/2" top spud, bolt caps, white.	American Standard 3461.528	Kohler K-96057
	SEAT: Commercial grade, solid plastic, elongated, open front, stainless steel check hinge, white.	Beneke 523-SS	Church 295NSSC
	FLUSH VALVE: 1.28-gallon flush, sensor operated, battery powered, externally adjustable, 1-1/2" top spud coupling, wall and spud flanges, vandalproof trim, chrome plated, ADA compliant.	Zurn ZER6000PL-HET-CPM	Sloan G2 Optima Plus 8111-1.28 (Rough-in to be lowered to 10” per manufacturer’s ADA installation requirements)
L-1	LAVATORY – EMPLOYEES – HANDICAPPED: 21" x 18", wall hung lavatory, 4" centers, concealed arms, front overflow and backsplash, white.	American Standard 0355.012	Kohler K-2005
	FAUCET: Battery operated sensor faucet, 4" centers, 0.5 gpm flow restrictor and mixing valve.	Sloan Optima Plus EBF-187	Zurn Z6950-XL-S
	SUPPLY: 1/2" O.D. x 3/8" O.D. angle supply, loose key stop, wall flange, chrome plated.	Brasscraft SR1712A	Kohler K-7676
	TRAP: 1-1/4" x 1-1/2", 17 ga., adjustable trap with cleanout and wall flange, chrome finish.	McGuire 8902	Kohler K-8999
	DRAIN: 1-1/4", 17 ga., offset drain with open grid strainer, chrome plated.	McGuire 155-WC	Kohler K-15592
		TP-L no longer in JSE specs	
	INSULATION KIT: Self-fastening, vinyl insulation covers for drain, traps and supply piping with accessible angle valve insulation cover, white.	McGuire PW2125WC	Handi Lav-Guard Model 102 and 105
	CARRIER: Adjustable floor support with concealed arms.		Smith 700 series
L-2	LAVATORY – EMPLOYEES – HANDICAPPED: 19" round, under mount lavatory, front overflow.	Sloan SS-3001	

	FAUCET: Battery operated sensor faucet, 4" centers, 0.5 gpm flow restrictor and mixing valve.	Sloan Optima Plus EBF-187	Zurn Z6950-XL-S
	SUPPLY: 1/2" O.D. x 3/8" O.D. angle supply, loose key stop, wall flange, chrome plated.	Brasscraft SR1712A	Kohler K-7676
	TRAP: 1-1/4" x 1-1/2", 17 ga., adjustable trap with cleanout and wall flange, chrome finish.	McGuire 8902	Kohler K-8999
	DRAIN: 1-1/4", 17 ga., offset drain with open grid strainer, chrome plated.	McGuire 155-WC	Kohler K-15592
		TP-L no longer in JSE specs	
UR-1	URINAL – SENSOR: Wall hung, siphon jet, vitreous china, 1/8-gallon flush, 3/4" top spud, white with extended lip.	American Standard 6590.525	Kohler K-4904-ET
	FLUSH VALVE: Externally adjustable 1/8-gallon flush, 3/4" top spud coupling, sensor operated, solenoid operator with hard wired transformer, wall and spud flanges, chrome plated.	Sloan Optima Plus 8186-0.125	Zurn ZEG6003EV
	CARRIER: Adjustable fixture hanger support and lower plate with bearing studs.	Jay R. Smith 635	Zurn Z1222
UR-1H	URINAL – HANDICAPPED – SENSOR: Wall hung, siphon jet, vitreous china, 1/8-gallon flush, 3/4" top spud, white with extended lip.	American Standard 6590.525	Kohler K-4904-ET
	FLUSH VALVE: Externally adjustable 1/8-gallon flush, 3/4" top spud coupling, sensor operated, solenoid operator with hard wired transformer, wall and spud flanges, chrome plated.	Sloan Optima Plus 8186-0.125	Zurn ZEG6003EV
	CARRIER: Adjustable fixture hanger support and lower plate with bearing studs.	Jay R. Smith 635	Zurn Z1222
MS-1	MOP SINK: 36" x 36" x 12” with 6" drop front, floor mounted, constructed terrazzo with 12” high walls, not less than 1” wide shoulders, factory installed stainless steel drain body designed to provide for a lead caulk or QDC3-2, combination dome strainer and lint basket, wall guard stainless steel panel, 3” cast iron p-trap, 36” long hose with stainless steel wall hook, stainless steel mop hanger.	Fiat TSB-3002 MSG3636 832-AA 889-CC	

	FAUCET: Wall mounted service faucet, 8” centers, ¾” hose thread, vacuum breaker, integral stops, adjustable wall brace, pail hook, chrome plated.	Fiat 830-AA	
MS-2	MOP SINK: 36" x 36" x 12"continuous, floor mounted, constructed of terrazzo with 12” high walls,, not less than 1” wide shoulders, factory installed stainless steel drain body designed to provide for a lead caulk or QDC3-2, combination dome strainer and lint basket, wall guard stainless steel panel, 3” cast iron p-trap, 36" long hose with stainless steel wall hook, stainless steel mop hanger.	Fiat TSB-500 MSG3636 832-AA 889-CC	
	FAUCET: Wall mounted service faucet, 8” centers, ¾” hose thread, vacuum breaker, integral stops, adjustable wall brace, pail hook, chrome plated.	Fiat 830-AA	
KS-1	BREAKROOM SINK – DOUBLE BOWL: Undermount 33" x 22" x 5-1/2" double.	ELUHAD311845	
	FAUCET: Battery operated sensor activated faucet with side mounted adjustable mixing valve, 1.8 gpm with multi-laminar spray, chrome finished cast brass, ADA compliant.	Pfister (Stellen) LG529-007-ESAC	
KS-2	BREAKROOM SINK – SINGLE BOWL: 25" x 21" x 5-1/2", nominal O.D. single bowl sink, undermount stainless steel, four-hole punch, ADA compliant.	Elkay ELUHAD211550	
	FAUCET: Battery operated sensor activated faucet with side mounted adjustable mixing valve, 1.8 gpm with multi-laminar spray, chrome finished cast brass, ADA compliant.	Pfister (Stellen) LG529-007-ESAC	
	DRAIN: Stainless steel strainer drain with removable crumb cup, 3-1/2" O.D., 1-1/2" tailpiece.	American Standard 4320-024	Kohler K-8813
EWC-1	ELECTRIC WATER COOLER EMPLOYEE – DOUBLE BOWL: Wall mounted barrier free bi-level coolers, front pushbutton operation, heavy gauge stainless steel, unit to provide minimum 8 GPH of 50°F water with 90°F ambient and 80°F supply water temperature, vinyl finish.	Halsey-Taylor HAC8FBL-Q	Oasis P8ACSL

	SUPPLY: 1/2" O.D. x 3/8" O.D., wheel handle stop.		McGuire ST07
	TRAP: 1-1/4" x 1-1/2", 17 ga. adjustable trap with cleanout, chrome finish.	Kohler K-8999	McGuire 8902
Footbath Station	Acrylic compact bowl, white Waste: floor outlet	Wudumate Model WM-COM-A-WT	
	FAUCET: Chromed brass.	Wudumate Model WM-T-SLP-SQ	

PART 3 – EXECUTION

3.01 INSTALLATION

A. All wall hung fixtures shall be supported on concealed chair carriers furnished complete with all necessary bolts, nuts, washers and gaskets unless noted otherwise. The adjustable nipple between the cast iron fitting and the closet bowl shall be threaded cast iron. Secure all floor pieces to floor slab.

B. All exposed piping in connection with fixtures shall be chromium plated. Where supply and waste lines pass through walls, provide chromium plated escutcheons and firmly secure in place.

C. Provide straight or angle supply valves on inlet supplies to all fixtures.

D. Fixtures, trim and methods of piping and installation shall conform to local plumbing code. All fixture types shall be the product of one manufacturer. All fixtures shall be white unless otherwise noted.

E. Fixtures shall be cleaned, adjusted and left in proper working order before the project is turned over to the Owner. Flush and clean all faucet aerators prior to turn over. Adjust all faucet lever handles to be parallel to adjacent rear wall in the off position.

F. The Contractor shall furnish and install protective guards as required to protect fixtures against damage by normal operations of other trades.

G. Caulk all floor and counter top mounted fixtures and behind all wall-hung plumbing fixtures with white, non-shrinking, silicone caulking eliminating all voids and cracks.

H. Coordinate the mounting height of all fixtures with the Architect prior to installation.

I. The Contractor shall obtain exact information relative to finish grade of the top of the floor drains. All floor drains shall be set flush with finished floors.

J. Cleanouts shall be provided where indicated on drawings and elsewhere as required by code.

K. Where test tees are installed at the base of the stack or on the stack, they may be used as a cleanout.

L. Provide the Owner with three (3) wrenches for removing flush cleanout plugs.

END OF SECTION

SECTION 23 0000
HVAC GENERAL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Refer to Division 1 - General Requirements and any and all Supplementary or Special Requirements, all of which apply to work described in Division 23 - HVAC as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all HVAC systems. All HVAC work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher implied cost shall be included in the bid, and the Architect shall be notified of the discrepancy in writing.

1.02 CODES AND STANDARDS

A. All HVAC work shall conform to all ordinances and regulations of the City, County and State where the work will take place, including the requirements of all authorities having jurisdiction. The following codes, standards and references shall be observed as a minimum:

1. 2018 Edition of the North Carolina Building Code
2. 2018 Edition of the North Carolina Mechanical Code
3. 2018 Edition of the North Carolina Fuel Gas Code
4. 2018 Edition of the North Carolina Fire Code
5. 2018 Edition of North Carolina Energy Conservation Code
6. 2017 Edition of North Carolina Electric Code
7. Current edition of locally adopted ASHRAE 90.1 standard
8. Local and State amendments
9. National Fire Protection Association (NFPA) Standards and Guidelines
10. Local and State Fire Marshal requirements
11. Local Building and Inspection Department requirements
12. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
13. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
14. Underwriters Laboratories Inc. (UL)

B. If Code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.03 WORK INCLUDED

The HVAC Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to:

A. Airside Systems
   1. Equipment: including fans, unitary air conditioners, air handling units, fan-coil units, furnaces, split systems, etc.
   2. Ductwork and Accessories: including sheet metal, flexible ductwork, fire and smoke dampers, access doors, etc.
   3. Air Terminal Devices: including powered induction units, variable air volume valves, etc.
   4. Air Distribution Devices: including louvers, registers, grilles, diffusers, etc.

B. Refrigerant Systems
   1. Piping, Tubing and Accessories: including pipe, refrigerant tubing, valves, solenoids, thermal expansion valves, strainers, air vents, pipe and equipment drains, condensate drains, etc.

C. Equipment, Ductwork and Piping Supports
   1. Equipment Mounts: including roof curbs, concrete housekeeping pads, equipment rails, miscellaneous steel, etc.
   2. Hangers and Support Devices: including inserts, hanger rods, unistrut, cross-bracing, anchor bolts, pipe anchors, restraints, etc.
   3. Vibration Isolation and seismic restraint: including inertia bases, flexible couplings, expansion devices, snubbers, springs, waffle pads, seismic restraints, etc.

D. Insulation
   1. Ductwork Insulation: including exterior duct wrap, internal duct liner, fire wrap, etc.
   2. Piping and Equipment Insulation: including preformed, board and wrap.

E. Miscellaneous HVAC Equipment: Unit heaters, wall heaters, roof hoods, etc.

F. Automatic Temperature Controls
   1. Decentralized: including all thermostats, control dampers, control valves, programmable controllers, line and low-voltage wiring, smoke detectors, pressure sensors, gas sensors, control logic, etc.
   2. Building Automation System (BAS): same as above but networked to a central human-machine computer interface, including all software and programming, display graphics, etc.

G. Labor and Equipment: including project management, supervision, tradesmen, lifts, fork-trucks, cranes, scaffolding, saws, wrenches, etc.

H. Equipment and Valve Identification

I. Start-up and Commissioning

J. Demonstration and Owner Training

K. Testing, Adjusting and Balancing

1.04 ENGINEER'S DRAWINGS

A. The locations, arrangement and extent of equipment, devices, ductwork, piping, and other appurtenances related to the installation of the HVAC work shown on the Drawings are approximate and define the intent of the design. The Contractor shall not scale Engineer's Drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

B. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do

not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.05 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. cited on the Drawings and in the Specifications are for the purpose of describing type, capacity, function and quality of equipment and materials required. All project design and coordination between disciplines has been performed as if the named manufacturer and specific piece of equipment will be provided to the project by the Contractor.

B. Alternate equipment and/or materials other than that named on the Drawings and in the Specifications may be proposed for use, but all equipment and materials shall conform entirely to the specified base items. Proposed alternate equipment shall be substantially equal in size, weight, construction and capacity. Alternate equipment and materials shall be submitted only as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Requests for prior approval of alternate products shall be made at least ten (10) days prior to the bid date and as required by Division 1 - General Requirements. The Engineer shall consider the use of the alternate equipment based on the supportive documentation made available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall, in all cases, be final.

C. The Contractor shall coordinate the installation of all HVAC equipment proposed for use in this project with all building trades (architectural, structural, electrical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the equipment submittals for approval. When the Contractor requests substitution of alternate equipment, it is with the knowledge that he shall be responsible for any and all costs required by the substitution, including necessary engineering and construction revisions in his or any other contract or trade to satisfy the design intent shown on the Plans and described in the Specifications.

1.06 SUBMITTALS

A. The Contractor shall prepare, submit and obtain Engineer's review of all manufacturers' data on the HVAC equipment and systems prior to ordering, purchasing or installing any equipment or materials. Six (6) hard copies of the complete submittal are required, five of which will be reviewed and returned by the engineer. Electronic submittals (e.g. .pdfs, etc.) may be acceptable, if approved by the architect and described in Division 1 – General Requirements. All submittals shall be transmitted simultaneously in hard ring binders (or in a single .zip file), with the associated specification sections cited and the items submitted clearly identified. Partial submittals will be returned without review. Submittals, as a minimum, shall include:

1. All HVAC items scheduled on the Drawings
2. Equipment arrangement, ductwork and piping drawings. Contractor drawings shall be prepared at a minimum scale of 1/8" = 1'-0". A scale of 1/4" = 1'-0" scale is preferred. Drawings shall be indicative of actual equipment purchased and shall show all offsets, transitions, fittings, dampers, valves, hanger locations, etc. Sections are required in spatially tight areas. The following will guide the Contractor as to minimum drawing detail required:
   a. Clearly indicate top and bottom of duct and pipe elevations. All elevations shall be coordinated as to not conflict with structural, plumbing, electrical and architectural trades.
   b. Indicate all offsets (both vertical and horizontal).
   c. Indicate graphically all duct and pipe joints and their lengths.
   d. Submit duct and pipe-work fabrication schedule indicating duct size range with minimum duct material gauges, pipe schedule being used,

duct and pipe connection joint types, section lengths, duct reinforcement type and spacing, etc.

e. Indicate graphically all ductwork to be fabricated with internal duct liner.

f. Indicate all insulation for ductwork and piping.

g. Indicate all dampers and valves as shown on design documents and called for in the specifications.

h. Indicate all flexible connectors where required by specifications and notes.

3. Flexible ductwork, insulation and linings
4. Dampers, louvers, air distribution devices
5. Manufacturer's cut sheets of all piping and tubing materials
6. Where split systems are used in a "long line application," submit manufacturer's refrigerant line set routing drawings and engineered calculations supporting the recommended suction and liquid line sizes. Identify and provide cut sheets of any and all accessories required to make the system complete, functional and reliable.
7. Valves, thermometers, pressure gauges
8. Roof curbs, equipment supports, hanger systems, vibration isolators, seismic restraints
9. Control equipment, systems and diagrams
10. Test and balance reports

B. All submittal approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of submittals by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines.

D. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

E. The Contractor shall provide a written statement confirming coordination of voltage requirements for all HVAC equipment requiring an electrical connection. Statement shall bear the names and signatures of the HVAC and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the Electrical Contractor.

HVAC Contractor: _____

Project Manager Name: _____

Project Manager Signature/Date: _____

Electrical Contractor: _____

Project Manager Name: _____

Project Manager Signature/Date: _____

1.07 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of the HVAC work and pay all charges incident thereto. He shall deliver copies of all certificates of permit and inspection to the Architect.

1.08 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Piping and other HVAC equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated ductwork, piping and other HVAC equipment installed should they interfere with the proper installation and mounting of electrical, plumbing equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all ductwork, piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The HVAC Contractor shall confirm that his work does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.09 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review. Manuals shall describe installation, operation and maintenance of all HVAC equipment and shall include copies of control schematics, sequences of operation, function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in (a) 3-ring binder(s).

1.10 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. The record shall be by red-line mark-up on the most current set of Engineer's Drawings kept in the field office. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Engineer's Drawings. As-built drawings shall accurately depict actual final arrangement of all HVAC items. As-built drawings shall be delivered to the Architect.

1.11 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. All reciprocating and scroll air conditioning compressors shall be provided with an extended 5-year parts warranty.

C. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase “make good” shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.01 GENERAL

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Engineer’s Drawings shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection Label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.02 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used in HVAC systems shall be as specified herein.

B. Motor controls, system controls, starters, pilot lights, push buttons, etc. shall be furnished by the HVAC Contractor complete as a part of the motor or apparatus that it operates. Electrical equipment shall be wired for the voltage shown on the Electrical Engineer’s Drawings.

C. Electric motors shall be high efficiency, open drip-proof type unless otherwise specified. Motors shall be standard NEMA continuous duty type and shall bear the UL Label. Motors shall be selected with a minimum of 15% safety factory greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7-1/2 HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall meet Table MG-1-12C of EPACT 1992.

D. Motors controlled by a variable frequency drive (VFD) shall be inverter duty rated and fully compatible with the VFD provided.

E. Starters for motors 1/3 HP and smaller shall be manual type, and for 1/2 HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

F. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein. Starters for motors 75 HP and greater shall be solid state, reduced voltage type.

G. Motor controls shall be either “Hand-Off-Auto” switches or “On-Off” push buttons with one indicating light. “Hand-Off-Auto” switches shall be provided for automatically controlled apparatus.

H. Motor starters that are not an integral part of HVAC equipment shall be installed in conformance with Division 26 - Electrical requirements.

I. Electrical power wiring to disconnects, starters, motors and similar devices shall be provided under the Electrical Section. All equipment requiring electrical power shall be installed with disconnect switches at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer's recommendations and electrical drawings.

J. The Contractor shall provide all system controls, control and interlock wiring 120 volts and less in conduits and in accordance with materials and installation requirements of Division 26 - Electrical.

K. All starters shall be labeled on the face of the starter with a semi-rigid plastic laminate nameplate with 1" high white letters on a black background securely affixed to the equipment. The label shall indicate equipment served by the starter (equipment tag used on the Drawings). Labels shall be furnished and installed by the Contractor.

L. All starters for 3-phase equipment shall have overload devices in each phase.

M. Wiring diagrams shall be furnished by the Contractor.

N. Acceptable manufacturers shall be General Electric, Square D, Cutler-Hammer, Siemens and Allen Bradley.

PART 3 – EXECUTION

3.01 GENERAL

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such time and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Listed mounting heights are to the finished bottom of the device unless otherwise noted.

E. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.02 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, and test plugs until final connection to system is made.

C. All equipment, piping and ductwork shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in a manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.03 CUTTING AND PATCHING

A. The work shall include all cutting and patching required as part of the HVAC installation. Refer to Division 1 - General Requirements.

3.04 CONCRETE WORK

A. Construct curbs, pads and similar supports for equipment where required.

B. Provide 4" thick housekeeping pads for all floor mounted equipment, extending 6" beyond the area occupied by the equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Division 3 - Concrete. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

D. Mix and install grout for HVAC equipment base bearing surfaces and anchors. Provide forms as necessary and place grout to completely fill equipment bases.

3.05 EQUIPMENT SUPPORTS

A. Major equipment supports (structural steel frames, framed structural slab and wall openings, etc.) shall be furnished and installed by others; however, the HVAC work shall include furnishing and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all HVAC equipment.

B. Unless otherwise shown on the Drawings, all HVAC equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural bar joists shall be supported only by the top chord of the joists. Hangers shall not be attached to the bottom chord of any joists.

3.06 PIPE AND DUCTWORK PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be schedule 40 black steel. Sleeves for ductwork shall be 20-gauge galvanized steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be between the sleeve and the insulation.

B. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

C. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

D. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration. Pipe penetrations through exterior walls shall be sealed weather-tight with expandable link type seals by Thunderline, Linkseal, or Engineer approved equal.

E. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL-rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, or approved equal. Refer to Division 7 - Thermal and Moisture Protection.

3.07 FLASHING

A. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in Division 7 – Thermal and Moisture Protection.

3.08 EQUIPMENT LABELING

A. All HVAC equipment shall be labeled. This shall include all central plant, air handling or air conditioning equipment, air terminals, and other similar and miscellaneous equipment.

B. Labels for air terminals or other devices shall be located for optimum visibility through access panel or removed ceiling tiles.

C. Equipment labeling shall be one of the following, unless noted or specified otherwise:
   1. Permanently attached plastic laminated signs with 1" high lettering
   2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel

3.09 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.

C. All water piping shall be chemically flushed and cleaned prior to circulating water through equipment.

D. After cleaning, filters shall be installed where required and all systems shall be tested and balanced.

E. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and left ready for use.

3.10 PAINTING

A. Painting will be done under Division 9 – Painting except as otherwise noted, but the HVAC Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The HVAC Contractor shall touch-up any equipment scratched in shipment or during installation to match original finish. Touch-up painting of HVAC equipment shall be part of the HVAC work.

C. Any visible ductwork through grilles, registers and diffusers shall be painted flat black.

D. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces not galvanized, including HVAC piping. Rust preventive painting shall be part of the HVAC work. Rust preventive paint shall be “Rust Destroyer” by Advanced Protective Products, Inc., Fairlawn, NJ, (201) 794-2000. Product shall have a 5-year warranty when applied directly over rust. Clean and prepare surface per manufacturer’s recommendations.

E. All painting and coating shall match the original finish and shall conform to the requirements detailed in Division 9 - Finishes.

F. Do not paint over equipment nameplates, nonferrous hardware, accessories or trim.

3.11 PRESSURE TESTING

A. Unless otherwise specified herein, all HVAC piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 100 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.

3.12 PERFORMANCE AND DEMONSTRATION TESTS

A. All testing and demonstration of any and all HVAC systems required for acceptance by any authorities having jurisdiction shall be included as part of the HVAC work. This shall include the furnishing of any and all testing equipment, smoke generation devices, and any other required equipment or accessories, and all necessary labor required to perform any required tests or demonstrations. The Contractor shall coordinate and verify all devices, equipment and sequence of testing and/or events with such authorities having jurisdiction. The Contractor shall perform a minimum of two (2) satisfactory preliminary tests or demonstrations prior to any formal tests and/or demonstrations for any code authorities, and shall give a minimum of five (5) days advance notice to the Engineer of any and all preliminary tests and/or demonstrations, indicating the date and time of such tests.

3.13 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner's key operating personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all HVAC equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all HVAC equipment and systems.

END OF SECTION

SECTION 23 0300
ROOF CURBS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.02 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work included under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install curbs complete as indicated on the Drawings and as specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

A. Prefabricated curbs for HVAC equipment located on the roof shall be manufactured by AES Industries, Custom Curb, Inc., Pate, Plenums Incorporated, Curbs Plus, Roof Products and Systems, Inc, or approved equal.

2.02 ROOF CURBS

A. Curbs shall be AES Model ASRC with Model AWS restrain bracket, fabricated to match any roof slope and have a minimum height of 24", as measured from top of bar joist to top of curb, and/or as required for no less than 18” of curb height above roof surface. Coordinate with the roof system used so that a minimum of 18" of the curb is above the finished roof for flashing purposes. The top of the curb shall be level and the slope of the roof shall be compensated for by the curb.

B. Curbs shall be heavy gauge construction as deemed necessary by the curb manufacturer to support unit load with fully mitered and welded corners and self-flashing without cant. The curb shall not sag more than 1" in 240" + or - when supporting the unit at the corners of curb only. The curb shall be internally reinforced with angle iron, factory insulated with 1-1/2" thick 3 p.c.f. density fiberglass insulation, and shall be complete with factory installed pressure treated full perimeter wood nailer, unit attachment/restraint brackets, gasket material, and assembly hardware Coordinate sizes to match frames provided by others. When the project is located within 5 miles of a sea coast, curbs shall be of aluminum construction.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer’s printed instructions and as detailed on the Drawings. Curb manufacturer shall coordinate with HVAC and General Contractor.

B. Attachment of curb to structure shall be coordinated with Structural drawings/details.

END OF SECTION

SECTION 23 0548
NOISE AND VIBRATION CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.02 MATERIAL AND EQUIPMENT

A. Vibration isolation mounts shall be supplied by one of the following approved manufacturers:

1.	Amber/Booth Co. (Houston, TX)	A.B.
2.	Mason Industries, Inc. (Hauppauge, NY)	M.I.
3.	Kinetics Noise Control, Inc. (Dublin, OH)	K.N.C.
4.	Vibration Eliminator Co., Inc. (Copiague, NY)	V.E.

B. Unless otherwise specified, supply only new equipment, parts and materials.

C. Substitutions of equal equipment beyond the alternatives listed will be permitted only with the written permission of the Architect. Accompany each request for acceptance of substitute equipment with manufacturer's certified data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.

D. Unless otherwise approved by the Architect, field-installed vibration isolation equipment shall be furnished by a single manufacturer or his authorized representative, who shall also be responsible for all work specified in this section to be performed by the manufacturer.

1.03 REQUESTS FOR CHANGE

A. Any requests for changes to the specifications must be submitted in writing at least ten (10) days prior to bid closing. Approval will be given through a written addendum.

1.04 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials such as mounting brackets, attachments and other accessories as may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any rotating equipment cause excessive noise or vibration when properly installed on the specified isolators, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required reducing noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

F. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

1.05 SUBMITTALS

A. Refer to related sections elsewhere for procedural instructions for submittals.

B. Before ordering any products, submit shop drawings of the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection.

1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:
   a. The equipment identification mark;
   b. The isolator type;
   c. The actual load;
   d. The static deflection expected under the actual load;
   e. The specified minimum static deflection.
3. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
4. Special details necessary to convey complete understanding of the work to be performed.

C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.

1.06 DESIGN REQUIREMENTS

A. Design isolators for equipment installed outdoors to provide adequate restraint to withstand the force as required by code to any exposed surface of the isolated equipment. Isolators for outdoor equipment shall have bolt holes for attachment to equipment and to supports. The vibration isolation Vendor shall submit verifying shear and over turning calculations, for their product and equipment installation arrangement, stamped by a licensed Professional Engineer. The design and supply of miscellaneous support steel above and below isolators will not be the responsibility of the vibration isolation manufacturer.

1.07 VIBRATION ISOLATION AND SEISMIC RESTRAINT

A. Scope

1. Provide isolators, flexible connections, and equipment bases for all rotating, piston driven, or vibrating equipment.
2. Guarantee specified isolation system deflections.
3. Provide installation instructions, drawings, and field supervision to ensure proper installation and performance of all items specified in this section.
4. Design, furnish, and install attachment devices, anchor bolts, and seismic restraints that are required for seismic compliance for all equipment, apparatus piping, conduit and raceways, ductwork, and other components of the specified systems required by codes and standards. "Attachment Devices" are devices such as double sided beam clamps, concrete inserts, and attachment plates that serve to secure the supported device into the structure.
5. Provide seismic restraint types as described. If the item to be restrained is not listed, select appropriate restraint and submit for approval.

6. In addition, seismic bracing for Fire Protection systems shall conform to NFPA 13.

B. Definitions
1. “Attachment Devices” are devices such as double sided beam clamps, concrete inserts, and attachment plates that serve to secure the supported device to the structure.
2. “Positive Attachment” is defined as a support location with a cast-in or wedge type expansion anchor, a double-sided beam clamp, or a welded or through bolted connection to the structure.
3. “Transverse Bracing” Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct, or conduit.
4. “Longitudinal Bracing” Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct, conduit, etc.
5. Life Safety Systems
   a. All systems involved with fire protection, including sprinkler piping, fire pumps jockey pumps, fire pump control panels, service water supply piping, water tanks, and fire dampers.
   b. All systems involved with and/or connected to emergency power supply, including all generators, transfer switches, transformers and all circuits to fire equipment.
   c. All systems involved with and/or connected to emergency power supply, including all generators, transfer switches, transformers and all circuits to fire protection, smoke evacuation and/or emergency lighting systems.

C. Reference Codes and Standards
1. 2006 Standard Building Code
2. “SMACNA Guidelines for Seismic Restraint of Mechanical Systems” - Second Edition (1998) with Addendum No. 1 (September 2000)
3. Seismic design category C

D. Exclusions from Seismic Restraint Requirements
1. With the exception of life safety components, certain components do not require seismic restraints. These are specified herein.

E. Submittal Data Requirements
1. Submittals:
   a. Catalog cuts or data sheets on specific products utilized, which detail compliance with the specification. Reference “TYPE” as per “PRODUCTS” section of this specification.
2. Shop Drawings
   a. Show base construction for equipment; include dimensions, weights, structural member sizes and support point locations.
   b. Indicate isolation devices selected with complete dimensional and deflection data before condition is accepted for installation.
   c. Calculate thrust for fan heads (axial and centrifugal fans) to determine whether thrust restraints are required.

F. Seismic Certification and Analysis
1. Seismic restraint calculations shall be provided for all connections of equipment to the structure. All performance of products (such as: strut, cable, anchors, clips, etc.) associated with restraints shall be supported with manufacturer’s data sheets or certified calculations.
2. Seismic restraint calculations shall be based on the acceleration criteria required by local codes. Note: For roof-mounted equipment, both the seismic acceleration and wind loads shall be calculated, the highest load shall be utilized for the design of the restraints and isolators.

3. Calculations to support seismic restraint design shall be stamped by a registered professional engineer with at least five years of seismic design experience.
4. Table elevations refer to the structural point of attachment of the equipment support system (i.e., use floor slab for floor supported equipment and the elevation of the slab above for suspended equipment).
5. Analysis shall indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure. Analysis shall detail anchoring methods, bolt diameter, embedment and/or weld length.
6. Certification and analysis report shall be submitted along with other mechanical submittals.

G. Manufacturer Inspection
1. Upon completion of installation of all vibration isolation and seismic restraint devices, a certification report prepared by the manufacturer shall be submitted in writing to the Contractor indicating that all systems are installed properly and in compliance with the specifications. The report must identify those areas that require corrective measures or certify that none exist. Any field coordination type changes to the originally submitted seismic restraint designs must be clearly defined and detailed in this report.

PART 2 – PRODUCTS

2.01 VIBRATION ISOLATOR TYPES

A. General
1. All metal parts installed out-of-doors shall be corrosion resistant after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.
2. Isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.
4. Static deflection of isolators shall be as provided in the EXECUTION section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

B. Type FSN (Floor Spring and Neoprene)
1. FSN isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1. Mounts shall have leveling bolts.
2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate size shall be provided to load the pad uniformly within the manufacturer's recommended range. If the isolator is to be fastened to the building and the NP isolator is used, the holes in the isolator base plate shall be oversized and GROMMETS shall be provided for each base plate bolt hole.

3. If the basic spring isolator has a neoprene friction pad on its base and an NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum bearing plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, bearing plates shall not be made of galvanized steel. The NP isolator, bearing plate and friction pad shall be permanently adhered to one another and to the bottom of the isolator base plate.
4. Type FSN isolators shall be one of the following products with the appropriate neoprene pad (if used) selected from Type NP or approved equal:
   a. Type SW A.B.
   b. Type SLF M.I.
   c. Type FDS K.N.C.
   d. Type OST V.E.
   e. Series AC V.M.&C.

C. Type FSNTL (Floor Spring and Neoprene Travel Limited)
1. FSNTL isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately 1. Mounts shall have leveling bolts. Mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4" shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate size shall be provided to load the pad uniformly within the manufacturer’s recommended range. If the isolator is to be fastened to the building and the NP isolator is used, the holes in the isolator base plate shall be oversized and GROMMETS shall be provided for each base plate bolt hole.
3. If the basic spring isolator has a neoprene friction pad on its base and an NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum bearing plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, bearing plates shall not be made of galvanized steel. The NP isolator, bearing plate and friction pad shall be permanently adhered to one another and to the bottom of the isolator base plate.
4. Type FSNTL isolators shall be one of the following products, with the appropriate neoprene pad (if used) selected from Type NP or approved equal:
   a. Type CT A.B.
   b. Type SLR M.I.
   c. Type FLS K.N.C.
   d. Type KW V.E.
   e. Series AWR V.M.&C.

D. Type FN (Floor Neoprene)
1. NP isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.
2. Type FN isolators shall be one of the following products or approved equal:
   a. Type RVD A.B.
   b. Type ND M.I.
   c. Type RD K.N.C.

d. Type D44 V.E.
e. Series RD V.M.&C.

E. Type FNC (Floor Neoprene Constrained)
1. FNC isolators shall incorporate bridge-bearing neoprene elements with all-directional restraint. The mount shall consist of a ductile iron casting containing two (2) separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. Bolt holes shall be provided in the base and the top shall have a threaded fastener.
2. Type FNC isolators shall be one of the following products or approved equal:
a. Type BR M.I.
b. Series RSM V.M.&C.

F. Type PCF (Pre-compressed Fiberglass)
1. PCF isolator blocks shall be made of molded inorganic glass fiber that is individually coated and sealed with an impervious elastomeric membrane. Fiberglass shall be severely overloaded during the manufacturing process to stabilize the material into a product that is permanent and has consistent, predictable dynamic properties.
2. Type PCF isolators shall be one of the following products or approved equal:
a. Type KIP K.N.C.

G. Type NP (Neoprene Pad)
1. NP isolators shall be one layer of 5/16" to 3/8" thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type NP isolators shall be one of the following products or approved equal:
a. Type NR A.B.
b. Type W M.I.
c. Type NPS K.N.C.
d. Type 200N V.E.
e. Series Maxi-Flex V.M.&C.

H. Type DNP (Double Neoprene Pad)
1. DNP isolators shall be formed by two layers of 1/4" to 3/8" thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:
a. Type NR A.B.
b. Type WSW M.I.
c. Type NPS K.N.C.
d. Type 200N (Multilayers) V.E.
e. Series Maxi-Flex V.M.&C.

I. Type HSN (Hanger Spring and Neoprene)
1. HSN isolators shall consist of a freestanding and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees arc before contacting the housing. Alternatively, other provisions shall be made to allow for a 30 degrees arc of movement of the bottom hanger rod without contacting the isolator housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring elements shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. The neoprene element shall be

designed to have a 0.3" minimum static deflection. The deflection of both the spring element and the neoprene element shall be included in determining the overall deflection of Type HSN isolators.

2. A pre-compressed glass fiber element may be substituted for the neoprene element.
3. Type HSN isolators shall be one of the following products or approved equal:
   a. Type BSR-A A.B.
   b. Type 30N M.I.
   c. Type SRH or SFH K.N.C.
   d. Type SNRC V.E.
   e. Type RSH 30A or RSHSC V.M.&C.

J. Type HN (Hanger Neoprene)
1. HN isolators shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing.
2. A pre-compressed glass fiber element may be substituted for the neoprene element.
3. Type HN isolators shall be one of the following products or approved equal:
   a. Type BRD-A A.B.
   b. Type HD M.I.
   c. Type RH or FH K.N.C.
   d. Type 3C V.E.
   e. Type RHD V.M.&C.

2.02 EQUIPMENT BASES

A. Type BSR (Base - Steel Rail)
1. Steel rail bases shall consist of structural steel sections sized to provide a rigid beam that will not twist, deform, or deflect in any manner that will negatively affect the supported equipment or the vibration isolation mounts. Rail bases shall include mounting brackets for attachment of vibration isolators.
2. Type BSR bases shall be one of the following products or approved equal:
   a. Type C or CIS A.B.
   b. Type R or ICS M.I.
   c. Type KRB or KFB K.N.C.
   d. Type CS V.E.
   e. Type WFR V.M.&C.

B. Type BSF (Base - Steel Frame)
1. Steel frame bases shall consist of structural steel sections sized, spaced, and connected to form a rigid base which will not twist, rack, deform, or deflect in any manner which will negatively affect the supported equipment or the vibration isolation mounts. Frames shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. The depth of steel frame bases shall be at least 1/10 the longest dimension of the base supported between isolators and not less than 6". The base footprint shall be large enough to provide stability for supported equipment.
2. Frame bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.
3. Type BSF bases shall be one of the following products or approved equal:
   a. Type WX A.B.
   b. Type WFSL M.I.

c. Type SFB K.N.C.
d. Type HB V.E.
e. Series WFB V.M.&C.

C. Type BIB (Base - Inertia Base)

1. Inertia bases shall be formed of stone-aggregate concrete (150 lb/cu. ft.) and appropriate steel reinforcing cast between welded or bolted perimeter structural steel channels. Inertia bases shall be built to form a rigid base that will not twist, rack, deform, deflect, or crack in any manner that would negatively affect the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the base supported between isolators and not less than 6". The base footprint shall be large enough to provide stability for supported equipment. Inertia bases shall include side mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment. Concrete may be provided by the General Contractor.
2. Frame and reinforcement for Type BIB bases shall be one of the following products or approved equal:
   a. Type CPF A.B.
   b. Type KSL or BMK M.I.
   c. Type CIB-L or CIB-H K.N.C.
   d. Type SN V.E.
   e. Series MPF or WPF V.M.&C.

D. Type RC-1 (Roof Curb, Type 1)

1. Type RC-1 isolation bases shall be a prefabricated assembly consisting of an extruded aluminum frame and steel spring isolation system that fits over the roof curb and under the isolated equipment. The aluminum frame shall be sufficiently rigid to support the equipment load without detrimental twist or deflection. Spring isolators shall be selected and positioned along the curb to achieve the minimum static deflection called for in the schedule. The static deflection shall be constant around the entire periphery of the base. Springs shall be free standing, laterally stable with a diameter of not less than 0.8 times the compressed height, and have additional travel-to-solid that is at least 50% of the rated deflection. Resilient neoprene snubbers shall be provided at the corners of the base to limit equipment movement to 1/4" under wind load.
2. The isolation curb base shall be made weather tight by sealing all around the periphery with closed cell neoprene or flexible membrane that shall in no way inhibit the vibration isolation of the spring elements. Closed cell sponge gasketing or field caulking shall be used between the equipment unit and the isolation curb base and between the isolation curb and roof curb to form a weather-tight seal. Each spring isolator used in the curbs shall be weather-protected as described in the PRODUCTS section under General.
3. Type RC-1 vibration isolation curb bases shall be supplied by the isolator manufacturer and shall be one of the following products or approved equal:
   a. Type RTIR A.B.
   b. Type CMAB M.I.
   c. Type ASR K.N.C.
   d. Type AR V.E.
   e. Series AXR V.M.&C.

E. Type RC-2 (Roof Curb, Type 2)

1. Type RC-2 isolation bases shall be a prefabricated assembly consisting of a structural steel frame and steel spring isolation system that also forms the roof curb under the isolated equipment. The steel frame shall be sufficiently rigid to support the equipment load without detrimental twist or deflection. Spring isolators shall be selected and positioned along the curb to achieve the minimum static deflection called for in the schedule. The static deflection shall be constant around the entire periphery of the base. Springs shall be free standing, laterally stable with a diameter of not less than 0.8 times the compressed height, and have additional travel-to-solid that is at least 50% of the rated deflection. Spring isolators shall include travel limit stops that are capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4" shall be maintained around restraining bolts as they pass through the limit stop brackets. Springs and limits stops shall be provided at the corners of the base to limit equipment movement to 1/4" under wind load.
2. The isolation curb base shall be made weather tight by sealing all around the periphery with closed cell neoprene, flexible membrane or light gauge spring metal loop, which shall in no way inhibit the vibration isolation of the spring elements. A closed cell sponge gasket or field caulking shall be used between the equipment unit and the isolation curb base and between the isolation curb and roof curb to form a weather-tight seal. Each spring isolator used in the curbs shall be weather-protected as described in the PRODUCTS section under General.
3. Type RC-2 vibration isolation curb bases shall be supplied by the isolator manufacturer and shall be one of the following products or approved equal:
   a. Type RSC M.I.
   b. Type SSR K.N.C.
   c. Vibrocurb ThyCurb

2.03 VIBRATION ISOLATOR SCHEDULE

Equipment Type	Base Type	Isolator Type	Minimum Deflection
Air Handling Units – Floor Mounted < 1 HP	-	DNPx2	1/10”
Air Handling Units – Floor Mounted > 1 HP	-	FNC	3/8”
Air Handling Units – Internally Isolated	-	DNPx2	1/10”
Air Handling Units – Suspended < 1 HP	-	HN	3/8”
Air Handling Units – Suspended > 1 HP	-	HSN	1”
Boilers	-	FSN	1”
Cooling Towers	-	FSNTL	4”
Fan Coil Units – Floor Mounted	-	DNP	1/10”
Fan Coil Units – Suspended	-	HN	3/8”
Fans – Floor Mounted < 1 HP	BSF	DNPx2	1/10”
Fans – Floor Mounted > 1 HP	BSF	FNC	3/8”
Fans – Suspended < 1 HP	-	HN	3/8”
Fans – Suspended > 1 HP	-	HSN	1”
Generator	-	FSNTL	2”
Generator Exhaust Pipe	-	HSN	2”
Heat Exchangers	-	FSNTL	1”
Pumps - Floor Mounted < 1 HP	-	DNP	1/10”
Pumps - Floor Mounted < 5 HP	BIB	FN	3/8”
Pumps - Floor Mounted > 5 HP	BIB	FSN	2”
Pumps - Suspended Inline	-	HSN	2”
Split System Condensing Units < 5 Tons	-	NP	1/10”
Split System Condensing Units > 5 Tons	BSR	FSN	1”
Split System Heat Pump Units < 5 Tons	-	NP	1/10”

Split System Heat Pump Units > 5 Tons	BSR	FSN	1”
Water Cooled Self Contained Units (Internally Isolated)	-	DNPx2	1/10”
Water Cooled Self Contained Units	-	FSN	2”
Water Source Heat Pumps – Floor Mounted < 5 Tons	-	NP	1/10”
Water Source Heat Pumps – Floor Mounted > 5 Tons	-	FSN	1”
Water Source Heat Pumps – Suspended < 5 Tons	-	HN	3/8”
Water Source Heat Pumps – Suspended > 5 Tons	-	HSN	1”

2.04 RESILIENT PENETRATION SLEEVE/SEAL

A. Resilient penetration sleeve/seals shall be field-fabricated from a pipe or sheet metal section that is l/2" to 3/4" larger than the penetrating element in all directions around the element, and shall be used to provide a sleeve through the construction penetrated. The sleeve shall extend 1" beyond the penetrated construction on each side. The space between the sleeve and the penetrating element shall be packed with glass fiber or mineral wool to within 1/4" of the ends of the sleeve. The remaining 1/4" space on each end shall be filled with acoustical sealant to form an airtight seal. The penetrating element shall be able to pass through the sleeve without contacting the sleeve. Alternatively, prefabricated sleeves accomplishing the same result are acceptable.

2.05 RESILIENT LATERAL SUPPORTS

A. These units shall either be a standard product of the vibration isolator manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements similar to Type FN that are specifically designed to provide resilient lateral bracing of ducts or pipes.

B. Resilient lateral supports shall be one of the following products or approved equal:

1. Type Custom A.B.
2. Type ADA M.I.
3. Type RGN K.N.C.
4. Type VERG or VPL V.E.
5. Type MDPA V.M.&C.

2.06 FLEXIBLE DUCT CONNECTIONS

A. Flexible duct connections shall be made from coated fabric. The clear space between connected parts shall be a minimum of 3", and the connection shall have a minimum of 1.5" of slack material.

2.07 GROMMETS

A. Grommets shall be made of neoprene or neoprene impregnated duct that is specially formed to prevent bolts from directly contacting the isolator base plate, and shall be sized so that they will be loaded within the manufacturer’s recommended load range.

B. Grommets shall either be custom made by combining a neoprene washer and sleeve, or be one of the following products or an approved equal:

1. Type Isogrommets MBIS, Inc. (Bedford Heights, OH)
2. Type WB Barry Controls (Brighton, MA)
3. Type HG Mason Industries Inc. (Hauppauge, NY)

2.08 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the resilient, non-hardening sealants indicated below:

1. Acoustical sealant D.A.P.

2.	BR-96 or AC-20 (AC-20 FTR - Fire Rated)	Pecora
3.	Sonoloc	Sanborn
4.	Acoustical Sealant #834 (Acrylic Latex)	Tremco
5.	Acoustical sealant	U.S.G.

PART 3 – EXECUTION

3.01 APPLICATION

A. General
1. Refer to the PRODUCTS section of this specification for vibration isolation devices identified on the drawings or specified herein.
2. The static deflection of all isolators specified herein is the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.

B. Major Equipment Isolation
1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on housekeeping pads. See architectural or structural drawings for details.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified hereunder.
3. Flexible duct connections shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings.
4. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the electrical portion of the specification.

C. Miscellaneous Mechanical Equipment Isolation
1. Miscellaneous pieces of mechanical equipment, such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks, and expansion tanks, which are connected to isolated piping systems, shall be vibration-isolated from the building structure by Type NP or Type HN isolators (selected for 0.1" static deflection), unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

D. Pipe Isolation
1. All refrigerant and drain piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:
   a. Within mechanical rooms;
   b. Within 50' total pipe length of connected vibration-isolated equipment (air handling units, etc.);
   c. At every support point for piping that is greater than 4" in diameter.
2. Piping shall be isolated from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals.
3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2", Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2", Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least 1/4" static deflection.
4. Where lateral support of pipes is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.

6. Provide flexible pipe connections as called for under Major Equipment above and wherever shown on the drawings.

E. Duct Isolation
1. All sheet metal ducts and air plenums that are within mechanical rooms or within a distance of 50' total duct length of connected vibration-isolated equipment (whichever is longer) shall be isolated from the building structure by Type FN, PCF or HN isolators. All isolators shall achieve 0.1" minimum static deflection.
2. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
3. Flexible duct connections shall be provided as called for above under Major Equipment and wherever shown on the drawings.

F. Seismic Restraints
1. Each battery exhaust fan and connected ductwork shall be provided with seismic restraints.

3.02 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General
1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer’s instructions.

B. Isolators
1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.
4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
5. Hanger rods for vibration-isolated support shall be connected to major structural members, not the floor slab between major structural members. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360 degrees about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and un-isolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. The installed and operating heights of equipment supported by Type FSNTL isolators or with Type RC-2 isolation bases shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide 1/4" clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.

11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, there is to be a minimum operating clearance of 1" between steel rails, steel frame bases or inertia bases and the floor beneath the equipment. The isolator mounting brackets shall be positioned and the isolators adjusted so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.
3. Isolation bases shall be installed in strict accordance with the manufacturer's instructions.

D. Flexible Duct Connections

1. Prior to installation of the flexible connection, sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section, and the gap between connected parts shall be uniform. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

F. Grommets

1. Where grommets are required at hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

G. Resilient Penetration Sleeve/Seals

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

END OF SECTION

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SECTION 23 0593
TESTING, ADJUSTING AND BALANCING (TAB)

PART 1 – GENERAL

1.01 DESCRIPTION

A. Refer to specification section 23 0000 - HVAC General, all of which applies to work described in this section as if written in full herein.

B. The work described by this section of the specifications consists of furnishing all materials, instruments, labor, and appurtenances to test, adjust and balance all of the HVAC systems furnished and installed under Division 23 of the specifications.

C. The TAB agency shall be a subcontractor of the General Contractor and shall not report to or be paid by the HVAC Contractor. The HVAC subcontractor shall be responsible to cooperate with and provide for the balancing subcontractor any and all materials, services, labor, etc. to facilitate completion of the balancing work.

1.02 QUALITY ASSURANCE

A. The TAB agency and its specialist shall be certified members of Associated Air Balance Council (AABC) or certified by the National Environmental Balance Bureau (NEBB) to perform TAB service for HVAC, and vibration and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. The TAB agency shall have been in business for at least the past five years and must be free of disciplinary action by either the AABC or the NEBB during that time.

B. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity of this project and must be certified so by the TAB agency in writing.

C. The basic instrumentation shall be calibrated to accuracy requirements by its manufacturer, AABC or NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems. Provide calibration history of the instruments to be used for test and balance purpose.

D. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by the ASHRAE Handbooks and requirements stated herein shall be the basis for planning, procedures, tolerances and reports. Final report shall cite the exact names of publications used as a basis or reference for the TAB work or reports.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

B. Provide for repair of insulation removed or damaged for TAB work to match installation.

PART 3 – EXECUTION

3.01 TAB PROCEDURES

A. TAB shall be performed in accordance with the requirements of the Standard under which the TAB agency is certified, either AABC or NEBB.

B. During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

C. Adjustment of the temperature controls shall be coordinated by the TAB work specialist in conjunction with the Automatic Temperature Control Company's Engineer. Both shall cooperate to simulate a complete cycle for every system in every mode of operation (automatic, economizer, fire emergency, etc.).

D. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

3.02 AIR SYSTEMS TAB

A. Systems shall be tested, adjusted and balanced so that air quantities and temperatures at outlets are as shown on the Contract Drawings and so that the distribution from supply outlets is uniform over the face of each outlet. Air quantities shall be balanced to within 10% +/- of the design values indicated on the plans.

B. Direct reading velocity meters may be used for comparative adjustment of individual outlets, but air quantities in ducts having velocities of 1,000 feet per minute or greater shall be measured by means of pitot tubes and inclined gauge manometers. Instrument test opening enclosures shall be provided as required at the direction of the TAB agency.

C. Adjustments shall be made in such a manner that splitter and volume adjusters close to air outlets will have the least pressure drop consistent with volume requirements. Primary balancing shall be obtained by adjustment of the dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities. Additional dampers or other air volume adjusters required to accomplish the balancing and adjusting shall be furnished and installed as part of the HVAC work.

D. Artificially load air filters by partial blanking to produce air pressure drop of at least 90 percent of the design final pressure drop.

E. Check and readjust factory set minimum and maximum air terminal unit flow rates if necessary. Balance air distribution on full cooling maximum. Reset room thermostats and check operation from maximum to minimum cooling, to the heating mode, and back to cooling. Record and report the heating coil leaving air temperature when in the maximum heating mode.

F. Adjust fan speeds to provide design air flow. Adjust V-belt drives, including fixed pitch pulley requirements.

G. After completion of the testing, adjusting and balancing of the air systems, six (6) copies of a recognized complete set of reports showing the minimum following information shall be submitted to the Engineer for review:
   1. Systems inspection narrative on equipment and installation for conformance with design
   2. Duct Air Leakage Test Report
   3. Systems Readiness Report
   4. TAB report covering flow balance and adjustments, performance tests, vibration tests and sound tests. Required information:
      a. Location of each air outlet or inlet. This shall be presented in the form of a reduced size floor plan showing outlet number keyed to the outlet number in the report.
      b. Dimensions or size of each outlet or inlet

c. Type and manufacturer of diffusers, grilles, registers. Indicate duty as supply, return, exhaust, etc.

d. Cfm of air as indicated on the Drawings for each outlet or inlet with corresponding velocity

e. Velocity of air as measured and corresponding cfm at which system has been balanced and adjusted, for each outlet or inlet

f. Velocity of air measured and corresponding cfm, after each complete system has been balanced and adjusted, for each main branch or zone duct at the supply fan, the return fan and the exhaust fan, as the case may be

g. After each complete system has been balanced and adjusted, the total cfm at fan discharge, the total return air to the apparatus, the total outside air to the apparatus, the total outside air to the apparatus, static pressure at fan outlet, total static pressure for apparatus, fan speed, motor amperage for each phase and voltage

5. Narrative of uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements

H. The above testing, adjusting and balancing shall be performed for the first season of the year, cooling season or heating season, which occurs at the completion of the building. Additional balancing and adjusting which may be required for the season of the year next following shall be performed as part of the work under this specification.

3.03 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements for all rotating HVAC equipment of 1/2 horsepower and larger, including centrifugal/screw compressors, cooling towers, pumps, fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to General Contractor. Where vibration readings exceed the allowable tolerance, the HVAC Contractor shall correct the problem and the TAB agency shall verify the corrections are done for final reporting.

3.04 SOUND TESTING

A. Perform and record required sound level measurements in approximately 15% of all rooms as designated by the General Contractor.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Where measure sound levels exceed specified levels, the installing contractor or equipment manufacturer shall take remedial action approved by the General Contractor and the necessary sound tests shall be repeated.

3.05 MARKING OF SETTINGS AND TEST PORTS

A. Following the approval of the final TAB Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the General Contractor.

B. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF SECTION

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SECTION 23 0700
HVAC INSULATION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 0000 - HVAC General.

1.02 WORK INCLUDED

A. The work done under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install all insulation, complete, as indicated on the Drawings and as specified herein.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Materials as specified in this section shall be manufactured by Armstrong, Johns-Manville, Manson, Knauf, Pittsburgh-Corning, Certainteed, Pabco, Dow Chemical, Owens Corning or approved equal.

B. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes					
Piping System Types	Fluid Temperature Range		Runouts 2 in. +	1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	°F	In.	In.	In.	In.	In.	In.
(Cooling Systems)								
Refrigerant (Armaflex)	Below 4.5	Below 40	1.0	1.0	1.5	1.5	1.5	1.5

C. Unless noted otherwise, the abovementioned piping systems inside the building shall be insulated with a 5 lb/cu. ft. (nominal) density sectional fiberglass insulation with a thermal conductivity (k factor) not to exceed 0.24. The jacket shall be fire retardant with a suitable vapor barrier. All joints and seams shall be sealed vapor tight. All joints and seams shall be lapped in place to form a continuous vapor barrier covering. All seams shall then be covered with “All Service Jacket” (ASJ) 3" wide tape. The tape shall match the jacket. The tape shall be squeegeed in place to provide complete adhesion of the tape to the jacket and to provide a continuous vapor barrier covering.

D. Provide high density preformed pipe insulation inserts at all pipe hangers. Inserts shall be equal to Foamglas by Pittsburgh Corning or calcium silicate. Provide ribbed hanger saddles by Centerline, Buckaroos, Inc. or approved equal.

E. All exposed insulated piping in mechanical rooms below 10'-0" AFF shall be protected by a corrugated aluminum jacket with bands 3'-0" on center.

F. Ductwork

1. Duct wrap shall be UL Listed fiberglass blanket insulation with foil vapor barrier. Punctures and tears in the foil jacket shall be patched with foil tape to maintain the integrity of the vapor barrier. Insulate sheet metal ductwork in the thicknesses and densities as listed below:
   a. Sheet metal supply and return ductwork in non-air-conditioned areas: 3" thick, 3/4 lb/ft3 density (min R-9.6).

b. Sheet metal supply and return ductwork in air-conditioned areas: 2" thick, 1-1/2 lb/ft3 density (min R-8.3).

c. Sheet metal outside air ductwork in non-air-conditioned areas: 3" thick, 3/4 lb/ft3 density (min R-9.6).

d. Sheet metal outside air ductwork in air-conditioned areas: 2" thick, 1-1/2 lb/ft3 density (min R-8.3).

2. Sheet metal supply and/or return air ductwork indicated to be internally lined in lieu of external duct wrap shall be lined with 1-1/2" thick 3 PCF fiberglass duct liner board (minimum R=6.5). All exposed duct work shall be painted.

G. All outside air ducts shall be insulated. Outside air ducts located within mechanical rooms shall be rigid fiberglass board as described above. All other outside air ducts shall be blanket type insulated as described above.

H. Exterior supply and return air ductwork shall be constructed of galvanized sheet metal lined with 2" thick 3 lb/cu. ft. duct liner board (R-8 min.). All seams shall be externally sealed watertight with a 20-year silicone caulk and coated with a rust preventive coating over the entire duct surface.

I. Provide insulating tape over all piping specialties to prevent condensation such as drain valves, drain plugs, combination temperature/pressure test plugs, etc.

J. All insulation must meet applicable codes for Flame Spread and Smoke developed ratings.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Shop drawing submittals shall include a complete package of materials and methods intended for use as described in this section.

B. All work shall be in strict accordance with applicable codes, ordinances and the manufacturer’s recommendations.

C. All work shall be performed in a professional workmanlike manner and standard trade practice. It shall be smooth in appearance and suitable for finish painting.

END OF SECTION

SECTION 23 0800
MECHANICAL COMMISSIONING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The "Conditions of the Contract" and applicable requirements of Division 1, "General Requirements" govern this section.

1.02 DEFINITIONS

A. Commissioning: The process and methods used to confirm that the design meets project criteria, the systems installed are fully functional, owner training is complete and record documentation has been provided to the owner.

B. Commissioning Checklist: A summary of activities (tests) that are to be conducted by the installing contractor to verify and document that the equipment and/or systems are complete per the contract documents and manufacturer's recommendations.

C. Building Systems Performance Verification: A walk through of the building systems with the installing contractor(s) and the owner representatives, where the contractor(s) demonstrates the building equipment and systems operations. During the demonstration, the operation of the systems will be evaluated and all deficiencies noted.

1.03 DESCRIPTION OF WORK

A. Purpose: To perform and document the testing required for the verification of the correct or specified operation of a system or piece of equipment.

B. Work Included: The work includes but is not limited to the completion of the pre-commissioning checklists as listed in this specification for the following equipment and/or systems:

1. 23 0900 – Instrumentation and Controls for HVAC
2. 23 3100 – Ductwork and Accessories
3. 23 3400 – Unitary Exhaust and Supply Fans and Ventilators
4. 23 7400 – Single Package Rooftop Air Conditioners
5. 23 8126 – Split System Air Conditioning

1.04 QUALITY ASSURANCE

A. The Contractor shall complete the commissioning checklists during the construction of the pertinent equipment. A copy of the completed checklists and subsequent information (pressure tests, manufacturer's start up reports) are to be included in the Operations/Maintenance manuals. A copy is also to be provided to the Construction Manager on the day of the performance demonstration.

B. The contractor and any of its subs shall be responsible to attend all commissioning meetings and performance demonstrations. Based on the project, the participation of a manufacturer's representative in the functional testing, training or both may be required. All parties shall provide competent individuals familiar with the project and capable of fully demonstrating equipment functions.

C. The commissioning checklists are to be completed as the system rough-in and equipment start-up progress with the construction schedule.

D. The mechanical contractor shall be responsible to attend all commissioning meetings and performance demonstrations as scheduled by the construction manager.

PART 2 – PRODUCTS

Not used

PART 3 – EXECUTION

A. The Contractor shall have the responsibility of coordinating the completion of the commissioning checklists with other contractors as necessary.

B. The commissioning checklists are to be completed at a time that will not impede the progress of other trade construction.

C. The contractor shall provide all equipment required to complete the commissioning checklists.

D. On the date the on-site building systems performance verifications are conducted, the installing contractor shall have completed all commissioning checklists including air balance, controls check out, equipment start up, etc. A copy of all documentation is to be on-site on the day of the walk-thru.

E. Copies of all commissioning documentation are to be included in the operations and maintenance manuals. This includes the air balance report, equipment start up reports, pressure testing, hydrostatic test reports, etc.

3.01 CLOSE OUT DOCUMENT REQUIREMENTS

A. The following are the minimum requirements for documentation for the specified equipment, devices, components or fixtures. Similar documentation will be required for other equipment, devices, components or fixtures not listed that are project specific.

B. These requirements are in addition to providing all commissioning checklists; start up reports, balancing reports, test reports, AHJ reports and any other specific items noted on the commissioning checklists.

C. HVAC – Provide O&M manuals, cut sheets and warranty information for scheduled HVAC equipment.

D. Plumbing - Provide O&M manuals, cut sheets and warranty information for scheduled plumbing equipment.

PART 4 - COMMISSIONING CHECKLISTS (see attached pages)

PLUMBING PIPING SYSTEMS COMMISSIONING CHECKLIST

# 1	The pipe test reports for domestic, sanitary and storm piping have been submitted.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	The underground sanitary main line has been inspected with a camera and is free of breaks and obstructions. A copy of the tape has been provided.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	The domestic hot water temperature has been set.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	An isolation valve has been installed on the hot and cold water lines serving each restroom.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	All plumbing fixtures operate correctly. Automatic and manual flush valves have been adjusted.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	Roof drains, horizontal leader, domestic hot and cold water pipe all are insulated.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 7	All main piping runs have been identified and valves have been tagged. A copy of the valve tag chart has been provided, framed and installed in the main valve room.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 8	Shut off valves installed are accessible.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 9	Plumbing fixtures have been caulked.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 10	All clean-outs have been installed and are accessible for maintenance.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 11	Piping is adequately supported where the piping does not sag.	☐ **Complete**	**Comments**
		☐ **N/A**	

# 12	Piping penetrations have been sealed to maintain fire ratings.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 13	No piping has been suspended from other pipe or equipment.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 14	Dielectric unions have been installed to connect dissimilar metal pipe.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 15	All gas piping inspections required by local code have been completed and reports submitted.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 16	Air chambers or shoktrols are installed where necessary to prevent water hammer.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 17	The system has been checked to ensure no parts are exposed to freezing conditions. Any areas exposed to freezing have been provided with an isolation means and the ability to be drained	☐ **Complete**	**Comments**
		☐ **N/A**	
# 18	The system has been disinfected and flushed as required by code	☐ **Complete**	**Comments**
		☐ **N/A**	
#19	Gas piping that is installed and is inaccessible is to be welded.	☐**Complete**	**Comments**
		☐ **N/A**	
# 20	Trap primers have been installed are identified, are accessible and operate correctly	☐ **Complete**	**Comments**
		☐ **N/A**	
# 21	Backflow prevention devices are installed as required, have been tested and certifications are attached in a plastic insert onto the device.	☐ **Complete**	**Comments**
		☐ **N/A**	
#22	Gas piping supports have been installed where piping does not sag.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 23	A rupture pan has been provided and is piped to the mop sink or nearest floor drain.	☐ **Complete**	**Comments**
		☐ **N/A**	

# 24	The hot water temperature has been tested to verify discharge temperature does not exceed 120 df.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 25	All necessary PRVs have been installed and are correctly set	☐ **Complete**	**Comments**
		☐ **N/A**	
# 26	The valves have been provided at the hot water heater that will enable the removal of the heater without interrupting domestic water service.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 27	The hot water expansion tank has been provided at each water heater.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 28	Booster pump system has been started up and adjusted by the manufacturer with documentation of the startup included with this checklist	☐ **Complete**	**Comments**
		☐ **N/A**	
# 29	Pressure tanks have been opened to the system and proper air charge verified and documented on the tank.	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF PLUMBING PIPING SYSTEMS COMMISSIONING CHECKLIST

REFRIGERANT PIPING COMMISSIONING CHECKLIST

# 1	The pipe testing has been completed and the reports have been included with this checklist.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	The fittings are wrought copper or wrought bronze, solder joint fittings, ANSI B16.22.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	All piping is installed with a 1/8” slope downward in the direction of the compressor.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	Oil traps and double risers are installed where oil return is required.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	The piping is seamless copper tube, hard drawn, type ACR ASTM B75 for all sizes or type K or L, ASTM B88.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	The dehydration process has been completed per Section 15530 and documents of the process are provided with this checklist	☐ **Complete**	**Comments**
		☐ **N/A**	
# 7	The piping system has been supplied with the full operating charge.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 8	The refrigerant lines have been adequately insulated. Refer to Spec Section 15250 for insulation requirements.	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF REFRIGERANT PIPING COMMISSIONING CHECKLIST

ROOFTOP CONSTANT VOLUME UNIT COMMISSIONING CHECKLIST

# 1	The installing contractor has completed the manufacturer's generated start-up checklist and a copy has been included with this checklist.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	The unit has been air balanced and a copy of the balancing report has been included with this checklist.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	The unit has been tied into and visible from the BAS (Building Automation System).	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	The final set of filter media has been installed and one spare set has been turned over to the owner.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	Condensing coil fins are not damaged and the interior of the unit is clean.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	All penetrations to the unit have been made in the manufacturers approved chase and not thru the drain pain or control cabinet.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 7	The gas or electric disconnect have not been installed in a manner in which it will not interfere with the unit access.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 8	The unit has been installed so that the condensate drains from the unit per manufacturer's recommendations. Condensate does not build up inside the unit.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 9	The unit does not transmit excessive noise or vibration to the occupied areas.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 10	All shipping materials have been removed, fan and filter section have been properly floated.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 11	Unit tested in all modes of operation and completely functional and adjusted.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 12	The unit smoke detector will shut down the unit when activated.	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF ROOFTOP CONSTANT VOLUME UNIT COMMISSIONING CHECKLIST

FANS AND VENTILATORS COMMISSIONING CHECKLIST

# 1	The fans have been started and the startup report provided with this checklist has been completed of each unit	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	The fans/ventilators are operating within the manufacturers recommended amp draws.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	The fans/ventilators are not producing excessive vibration or noise.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	The fans/ventilators have been secured to the roof curbs.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	The belt tensions on the fans and ventilators have been checked and are per the manufacturer's recommendations.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	The fans/ventilators have been installed with a local means of disconnect.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 7	The fans/ventilators have been tested and operated with the local control means. (t-stat, on-off switch, smoke detectors, BAS system.)	☐ **Complete**	**Comments**
		☐ **N/A**	
# 8	The fans/ventilators are not dented or show other signs of visible damage.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 9	If controlled with a motor starter, heater sizing/adjustment has been checked and is accurate	☐ **Complete**	**Comments**
		☐ **N/A**	
# 10	The systems have been balanced and reports are included with this checklist.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 11	Backdraft dampers & motorized dampers operate freely. Down and upstream dampers (smoke, fire, et) have been checked and are open to allow free flow of air.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 12	If used for stairway/corridor pressurization during fire, have all proving methods been tested and adjusted.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 13	If used for smoke exhaust, have all proving methods been tested and adjusted, has the equipment confirmed as being certified for the use.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 14	All code required evacuation and pressurization tests have been completed and documentation has been included with this checklist.	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF FANS AND VENTILATORS COMMISSIONING CHECKLIST

DUCTWORK COMMISSIONING CHECKLIST

# 1	The general condition of the ductwork is good. There are no dents, rust or other signs of discoloration.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	Flexible ductwork connections have been made to air handlers, fans and similar equipment. The flexible ductwork connection is airtight.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	The ductwork hanger system has been installed where the ductwork is supported rigidly and the duct is held true to shape. There is no buckling of the ductwork.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	The ends of ductwork that are not in use shall be capped with a temporary closure.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	Flexible ductwork runs do not exceed eight feet.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	Ductwork joints have been sealed to prevent leakage.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 7	All balancing and volume dampers are in place and operate freely.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 8	All fire/smoke dampers are open and there are no obstructions	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF DUCTWORK COMMISSIONING CHECKLIST

BUILDING AUTOMATION SYSTEM (BAS) COMMISSIONING CHECKLIST

# 1	All work stations, handheld devices, etc. required for the project are per specification and fully operational.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 2	No integrated building system is “running wild” and all parameters of system control are being met.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 3	All graphics including tenant space graphics are complete and accurate per Tenant standards and specifications.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 4	All control wiring and devices prior to start-up have been tested. This includes verifying that all wiring is properly connected and free of all shorts and ground faults. Verify that all connections are tightened appropriately.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 5	All analog output devices are functional, start point and span are correct, and that direction and normal positions are correct including fail-safe positions. All control valves and automatic dampers have been checked to ensure proper action and closure.	☐ **Complete**	**Comments**
		☐ **N/A**	
# 6	Digital output devices operate properly and the normal positions are correct.	☐ **Complete**	**Comments**
		☐ **N/A**	

END OF BUILDING AUTOMATION SYSTEM (BAS) COMMISSIONING CHECKLIST

Pipe Test Report Form

Project Name: _____

Building: _____

Project Number: _____

TEST RESULTS

I. **Domestic Water Piping. (Hot, Cold, Make-up Water)**
Location:
Floor: _____
Column line: _____

1. Normal Operating Pressure _____Psig.
2. Test Pressure _____Psig.
3. Water Temperature_____Degrees F.
4. Length of Test _____Hours.

II. **Storm and Sanitary Waste Piping.**
Location:
Floor: _____
Column line: _____

1. Water Head on Main = _____Ft. of Water.
2. Length of Test = _____Hours.

III. **Air and Gas Piping.**
1. Air Pressure = _____Psig.
2. Length of Test = _____Hours.

IV. **Refrigerant Piping.**
1. Vacuum Test Pressure = _____Psig.
2. Length of Test = _____Hours.

Test Approval (Contractor) _____ Date: _____

Test Witness (Owner)_____ **Date:** _____

Filter & Belt Inventory

As part of the commissioning process, the contractor is required to provide the following information for each piece of equipment installed on the site.

Equipment Tag	Equipment Location	Belt Sizes	Belt Quantity	Filter Sizes	Filter Quantity

Fans & Ventilators Start Up Report

Job Name:

Start Up Date: Technician:

Make: Model: Tag ID:

Design Volts: _____/_____/_____ Actual Volts: _____/_____/_____

Design Fuse/Breaker Size: _____ Actual Fuse/Breaker Size: _____

Design Amps: _____/_____/_____ Actual Amps: _____/_____/_____

Motor Control Type: Relay:_____ Starter:_____ Other (specify)_____

Required overload size/settings: _____ Actual overload size/settings: _____

HOA Switch operational: _____

Differential pressure switch setting (if equipped):_____

Damper Type: gravity_____ Automatic_____ Other (specify)_____

Damper End Sw (Y/N): _____ End Sw Operational and Adjusted (Y/N): _____

Dampers operate smoothly (Y/N):_____ Down/Up stream fire/smoke dampers open (Y/N): _____

Motor & Fan bearings lubricated (Y/N): _____ Drive Type: Belt_____ : Direct_____

Belt(s) properly tightened (Y/N): _____ Belt Size: _____ Belt Qnty: _____

Connection to BAS Completed and operates correctly (Y/N): _____

All shipping materials removed (Y/N): _____

Comments

Commissioning via the BAS is also required for these boxes.

A complete T&B from a certified agency is also required for these units if distribution ductwork is connected.

END OF SECTION

SECTION 23 0900
INSTRUMENTATION AND CONTROL FOR HVAC V4.4

PART 1 – GENERAL

1.01 SPECIFICATIONS NOMENCLATURE

A. Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
SI	Systems Integrator
ES	Enterprise System
SCP	Stand Alone Control Panel
DDCS	Direct Digital Control System
BMS	Building Management System
NAC	Network Area Controller
IDC or BC	Interoperable Digital Controller/Building Controller
ASC	Application Specific Controller
PCU	Programmable Control Unit
GUI	Graphical User Interface
HMI	Human Machine Interface (Wall/Panel mounted display)
WBI	Web Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
BIBB	BACnet Interoperability Building Blocks
RH	Relative Humidity

1.02 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:
1. Section 23 0000 - HVAC General
2. Section 23 0993 - Sequence of Operation for HVAC Controls
3. Section 25 1300 – Integrated Automation System (IAS)

C. The following divisions constitute related work:
1. Division 01 – General Requirements
2. Division 23 – Heating, Ventilating and Air Conditioning
3. Division 25 – Integrated Automation System
4. Division 26 – Electrical
5. Division 28 – Electronic Safety and Security

1.03 OVERVIEW

A. Client has standardized on ASHRAE Standard 135-2010, BACnet/IP and BACnet MS/TP Control System architecture as the preferred communication method for the BMS. The division of work for this project is segmented between Division 23 (Controls) and Division 25 (Systems Integration). Divisions 23 and 25 shall be supported by a preselected Controls Contractor and Systems Integrator (SI). The SI is responsible for coordinating

the consistency of the local operator workstation system graphics, providing Network Area Controllers (NACs), global logic and sequences. The Division 23 Controls Contractor and Division 25 Systems Integrator shall be CBRE|ESI.

B. The General Contractor of this project shall directly hire CBRE|ESI.

1. Contact:
Roland Gutknecht | Senior Account Executive
CBRE | ESI
Global Workplace Solutions | Global Energy & Sustainability
3410 Gateway Road | Brookfield, WI 53045
T +1 262 832 1311 | F +1 888 280 8837 | C +1 414 507 0999
Roland.Gutknecht@cbre.com | www.cbre.com | www.thinkesi.com

C. The purpose of this specification's BMS architecture is to provide an open, common, easily expandable, non-proprietary and enterprise level front end/user interface that is maintained through a single global logic platform and provider to insure uniformed application, implementation and user experience throughout Client's portfolio of buildings, as well as a process that adheres to Client's standards and requirements while taking advantage of local representation for the majority of the field device applications and ongoing service for those devices.

The Division 25 SI shall provide NAC panels, global logic sequences, GUI, schedules and alarming. The Division 25 contractor shall provide field devices and controllers supporting application specific real time control logic. The Division 25 SI and Division 23 contractor shall work together in constructing a final BMS architecture that meets the full intent and requirements of this specification.

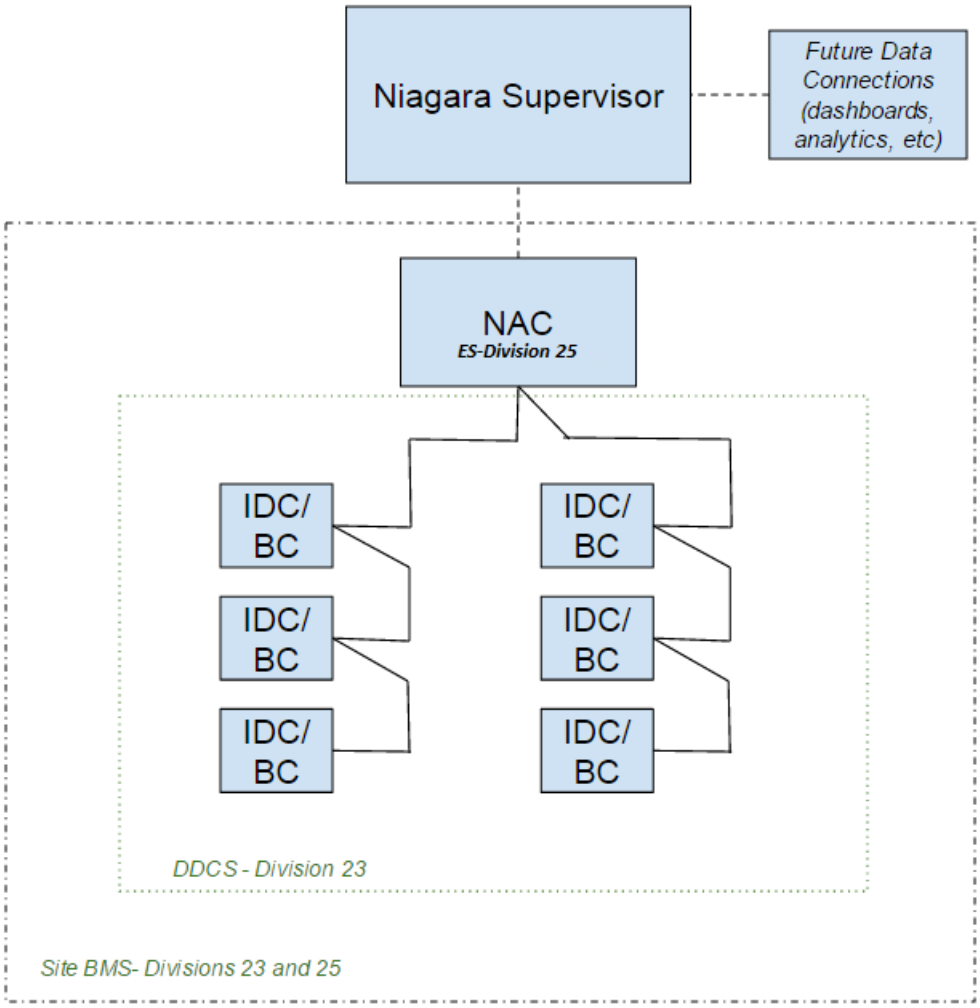
The Division 25 SI shall be responsible for testing the final control logic for the BMS. The Division 23 Controls contractor shall implement and test all control logic as it pertains to that portion of work associated with those devices, services and deliverables included in this specification.

D. General: The local Building Management System (BMS) system shall be a BACnet protocol system capable of integrating unit DDC controllers within a web-based network interface. The system interface will depict each mechanical system and building floor plan by a point-and-click graphic. An existing centralized SQL server shall gather the data from the site.

E. Client will operate an Enterprise level management system provided through a Niagara N4 platform. The Enterprise System (ES) will be Niagara N4. The local Building Management System (BMS) shall be Niagara N4 and, must be compatible with the ES without additional hardware or software expense. Controllers shall be supplier agnostic, however must be open platform to facilitate any vendor to maintain/modify. Specific compatibility requirements are detailed within Division 23 09 93.

F. System Architecture: As aforementioned the Client Enterprise System will be implemented through the Niagara N4 architecture. The unit DDC controllers as depicted below, broken out by 'dashed lines', will be open bid and sourced from the approved supplier list, have BACnet interface, and capable of integrating seamlessly into the Niagara N4 platform.

1. The Client enterprise systems, enterprise programming, and local BMS mapping ALL to be implemented via the Niagara N4 architecture.
2. BMS connected devices and HVAC DDC interface to be provided via specified and approved supplier list below.



G. The entire Direct Digital Control System (DDCS) shall be comprised of a network of interoperable, stand-alone, fully programmable digital controllers (IDC) communicating via BACnet/IP or BACnet MS/TP protocol (provided under Division 23 Controls) to Network Area Controllers (NACs) (provided under Division 25).
   1. Interoperable Digital Controllers (IDC) shall be:
      a. Distech – BACnet/IP
      b. Easy I/O FG-Series – BACnet/IP
      c. Distech – BACnet MS/TP
   2. NACs provided under Division 25 shall be based on the Niagara N4 Framework-Vykon Brand

H. The DDCS shall include all Ethernet network, BACnet MS/TP trunk wiring or other wiring, as necessary, to create a control network that shall connect all field controllers, field devices, NAC's, routers, switches and other network devices as may be indicated on the riser diagram.

I. Although BACnet/IP and BACnet MS/TP are the preferred communication protocol between field controllers and NACs it is acknowledged that not all factory provided controls may support a BACnet/IP or BACnet MS/TP option. In the event factory mounted controls/solutions are not capable of BACnet/IP or BACnet MS/TP the following communication protocols are acceptable in the following order of preference and only with prior written approval; Modbus TCP/IP, Modbus Async (RTU).

J. Factory mounted controls:

1. Where factory controls are provided and support BACnet/IP, BACnet MS/TP, Modbus TCP/IP or Modbus RTU communication methods the controls shall be connected directly to a Division 25 provided NAC communication port. Division 25 shall provide all communication wiring (BACnet MS/TP and Modbus RTU), all other wiring shall be provided and installed by the Division 23 (Mechanical) contractor. The wiring, wiring installation and termination for this connection shall be provided by the Division 23 (Mechanical) contractor. Where the device is considered to be associated with a critical process and the device supports I/O the Division 23 contractor shall also hard wire the appropriate I/O to an IDC.
2. The following control options will be allowed for factory RTU equipment:
   a. Carrier: RTU Open, BACnet MSTP
   b. Lennox: Prodigy, BACnet MSTP
   c. Trane: ReliaTel, BACnet MSTP
3. The BACnet RTU controller shall expose at a minimum the following points and provide the required read and or read/write access:

Point Description	Read	Read/Write	Note
Active Alarm Code(s)	X		*List of Possible Alarms*
Active Setpoint	X		
Cooling Enable (Command or Setpoint)		X	*Provide Range of Values*
Cooling Stage(s) Status	X		
Discharge Air Temperature	X		
Economizer Enable (Command or Setpoint)		X	*Provide Range of Values*
Heating Enable (Command or Setpoint)		X	*Provide Range of Values*
Heating Stage(s) Status	X		
Minimum Outside Damper Position		X	*Provide Range of Values*
Occupancy Command		X	
Occupied Cooling Setpoint		X	*Provide Range of Values*
Occupied Heating Setpoint		X	*Provide Range of Values*
Outside Air Temperature		X	
Outside Damper Position	X		
Power Exhaust Fan(s) Status	X		
Return Temperature	X		
Supply Fan Command	X		
Supply Fan Speed	X		
Supply Fan Status	X		
Unit Alarm Status	X		
Unit Operating Mode	X		*List of Possible Modes*
Unoccupied Cooling Setpoint		X	*Provide Range of Values*
Unoccupied Heating Setpoint		X	*Provide Range of Values*
Zone Temperature	X		

4. Where factory controls are provided with outputs/inputs only or communication protocols other than BACnet/IP, BACnet MS/TP, Modbus TCP/IP or Modbus RTU, the Division 23 contractor shall interface those points necessary to accurately monitor and control the system(s) through connections to an interface provided by the Division 23 Controls contractor. The Division 23 Controls contractor shall provide and expose the associated points to the Division 25 SI

via BACnet/IP or BACnet MS/TP. Where the device is considered to be a critical process and the device supports I/O the Division 23 Mechanical contractor shall also hard wire the appropriate I/O to the IDC.

K. The Division 23 (Controls and Mechanical) contractor shall also provide connections to other devices/sub systems that may not be directly part of the HVAC system as identified in the bid documents.

1. The gas and water meters are furnished or installed under this division of work and require integration to the BMS under this section.
2. The fire alarm/FACP interface, power meters, air compressor interface, and generator interface are furnished under another division of work but require integration to the BMS under this section.
3. These systems include but are not be limited to:

System	Communication Method	Points for integration to BMS	Interface (provided by)
Fire Alarm - FACP	Hard-wired IO	Alarm, Supervisory, Trouble	Relay board (Div 26)
Power Meter(s) Note: Sub-meters located at each MSB.	Modbus TCP	kW, kWh, PF, V, A, Quality	EGX Gateway (Div 26)
Gas Meter(s)	Hard-wired IT	Flow, Consumption	n/a (Div 23 - Controls)
Water Meter(s)	Hard-wired IT	Flow, Consumption	n/a (Div 23 - Controls)
Air Compressors	Modbus TCP or BACnet IP	Status, Alarms	Gateway (Div 23 - Mechanical)
Generator	Modbus TCP or BACnet IP	Status, Alarms	Gateway (Div 26)
Lighting Control Panels – coordinate with Div 26	Hard-wired IO	occupied, unoccupied	Relay board (Div 26)
HVLS fans	Modbus TCP or BACnet IP	status (on/off/rotation direction/speed), alarm	n/a (Div 23 – Controls)
Battery Charging Area Hydrogen Sensors	Modbus TCP or BACnet IP	status, alarm	n/a (Div 23 – Controls)
UPS @ MDF room	Modbus TCP or BACnet IP	status, alarm	n/a (Div 23 – Controls)
MDF controls	Modbus TCP or BACnet IP	status, temperature, humidity,alarms	n/a (Div 23 – Controls)

4. These systems are provided with a BACnet IP, BACnet MS/TP, Modbus TCP/IP, Modbus RTU, Lon Talk or other communication method, and the device shall be connected directly to a NAC communication port (provided by Division 25 SI). The wiring installation and termination for this connection shall be provided by the Division 23 Mechanical contractor.
5. Division 23 contractor shall provide sufficient wiring and IDC(s) for those points necessary to accurately monitor and/or control the system(s) as indicated on the plans and/or in the points matrix, through connections to a NAC (provided by the Division 25 SI).

L. It is the owner's expressed goal to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project, software shall have the appropriate licensing to allow the software to function fully with respect to its use for this project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall determine which organizations to be named in the SI organization ID ("orgid") of all software licenses. Owner shall be free to direct the modification of the "orgid" in any software license, regardless of supplier.

M. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.

N. The system shall provide protection against excessive demand situations during startup periods by automatically introducing time delays between successive start commands to heavy electrical loads.

O. Upon the resumption of power, each SCP shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.

P. System shall have the ability to ramp open or closed any output to allow for non-instantaneous operation of a device.

Q. History files shall not be programmed to reside on the IDC. All histories shall be recorded and stored at the network level (NACs).

R. All control components such as controllers, communication modules, switches, servers, LAN connectors, etc. shall be mounted in cabinets. Cabinets shall be single door UL 508A enclosures with hinged doors. All cabinets shall be provided with locksets that match.

S. No critical processes such as chiller plants, pump plants, cooling towers or central fan stations shall require network communication for either normal, redundant or emergency operation. Any use of network communications for operation of interrelated mechanical equipment shall be identified in original shop drawings and shall not be built until approved.

T. All RS485 communication trunk wiring topology shall be constructed in such a manner that controls from differing manufacturers do not communicate/reside on the same trunk; unless authorized by the Division 25 SI.

U. The Division 23 Controls contractor shall provide a list of network requirements for the project to include but not limited to: quantity of ports and IP addresses, software ports, etc. to Client with the bid submittal and project submittal package.

V. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP protocol or dedicated communication network using the BACnet MS/TP protocol.
   1. The use of BACnet Ethernet is prohibited.

PART 2 – MATERIALS

2.01 GENERAL

A. The Direct Digital Control System (DDCS) shall be comprised of a network of interoperable, stand-alone digital controllers and other devices as specified herein.

B. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.02 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a fully networked, distributed control system based on the BACnet communication protocols. It is the intent of this specification to provide a system that is comprised of all BACnet communicating devices. All IDC's, whether of the ASC or PCU type, shall be of one manufacturer. Systems based on IDC's from multiple manufacturers shall not be permitted (are not acceptable - without prior written approval).

2.03 CONTROL SYSTEM HARDWARE

A. BACnet CONTROLLERS – GENERAL REQUIREMENTS
   1. Controls shall be microprocessor based Interoperable BACnet Controllers in accordance with the ANSI/ASHRAE Standard 135-2010. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. The DDCS contractor must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard 135-1995. The BACnet application shall conform to, at a minimum, compliance Level 3; with the ability to support data read and write functionality.
   2. The IDCs shall communicate with the NAC via BACnet/IP at a baud rate of not less than 10 Mbps, or an MS/TP connection at a baud rate of not less than 38.4 kb (78.6 kb preferred).
   3. BACnet devices must be supplied using the IP or MS/TP communications method. The preferred BACnet MS/TP wire jacket color is orange however any color that is unique and distinguishable from all other communication wiring at the facility is acceptable.
   4. Where applicable, control shall be accomplished through BTL based devices where the application has a BACnet BIBB defined. Where BTL devices are not available for a particular application, such as some freely programmable controllers, the DDCS Contractor must provide complete product technical documentation including a complete listing of BACnet devices, BACnet objects, object types and object instances. This information shall be provided to the Division 25 System Integrator. The manufacturer's published BACnet PICS and BIBB statements shall be provided to the Division 25 SI for each controller defining the programming or setup of each device. The DDCS Contractor shall provide all programming and documentation necessary to set up and configure the supplied devices per the specified sequences of operation.

5. The DDCS Contractor shall route BACnet MS/TP network trunks to the Network Area Controller (NAC) as indicated. Coordinate locations of the NAC with the Division 25 System Integrator and Contractor to ensure that maximum network wiring distances, as specified by the BACnet wiring guidelines, are not exceeded. A maximum of 35 devices may occupy any one BACnet MS/TP trunk.
6. BACnet addresses on each trunk shall be sequential and non-conflicting starting at 2.
7. The Division 23 Controls contractor shall be responsible for assigning BACnet addresses.
8. The Network Area Controller (NAC), supplied by the Division 25 System Integrator, shall provide all scheduling, alarming, trending, and network management for the BACnet-based devices.

B. Modbus CONTROLLERS – GENERAL REQUIREMENTS
1. Controls shall be microprocessor based Interoperable Modbus RTU or TCP/IP controllers in accordance with Modbus-IDA standards. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
2. The use of Modbus RTU to TCP/IP conversion modules, drivers or gateways shall include a manufacturer's statement of operability.
3. All data must be available and/or mirrored within the Modbus 4x or "Holding Register" memory area. The other areas can be optionally supported, but all 0x, 1x, and 3x data must be readable in the 4x memory area. For digital writes, support of single-bit writes (function 5) to the 0x area are acceptable. Products that require access to the 1x and 3x area to operate are not acceptable; access to 1x/3x area must be optional.
4. Register 4x00001 must exist and be readable to allow simple, predictable "comm tests.
5. Software tools must be configurable to limit reads and write to user selectable limits; the software must accept being limited to reading 1 register per transaction and writing 1 register per transaction.
6. Software tools must allow setting to the Modbus/TCP "Unit Id" to a value other than zero. This is required for Ethernet-to-Serial bridging.

2.04 INTEROPERABLE DIGITAL CONTROLLERS (IDC)

A. IDC controllers shall be microprocessor based interoperable controllers.

B. The IDC category of controllers includes ASCs and PCUs devices.

C. Provide IDC's and ancillary devices as herein specified, as indicated on the drawings, and as necessary to perform the sequences of operation. The following equipment to be controlled shall include but not be limited to:
1. Rooftop packaged air conditioners
2. Gas-fired space heaters/Make-up Air Units
3. Exhaust Fans for ventilation and pressurization control
4. Louvers with motorized dampers
5. Additional equipment outlined herein or on the Mechanical and Electrical Drawings.

D. The complete IDC, including accessory devices such as relay, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

E. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

F. All IDCs shall be fully application programmable and shall at all times maintain their certification, if so certified. All control sequences within or programmed into the IDC shall

be stored in nonvolatile memory, which is not dependent upon the presence of a battery, to be retained.

G. The DDCS Contractor supplying the IDC's shall provide, at a minimum, the following documentation for each device dependent on communication protocol:
   1. BACnet: Network configuration parameters name and type (AI, AO, AV, MV, BI, BO, BV), BACnet Object Type, Object Instance, Object Name and Object Description
   2. Modbus: Modbus register list, scale factors and offsets.

H. It is the responsibility of the DDCS Contractor to ensure that the proper BACnet objects are provided in each IDC and are exposed for connection to them by the Division 25 System Integrator, as required. Use of manufacturer-specific BACnet objects shall not be permitted, unless software is provided to allow the use of them by any third-party network management tool (prior written approval required).

I. The DDCS Contractor supplying the IDCs shall (in addition to the above) provide graphical printouts of all/each IDC programming in PDF or PNG formats. Printouts shall include clear indication of how all input and output network variables interact with the controller process.

J. The DDCS Contractor shall provide two copies of the IDC programming tool and configuration tool, with documentation, to the owner.
   1. This tool shall allow the owner to fully program, configure, diagnose and otherwise manage the controller, without limitations.
   2. The tool shall be of the latest revision currently in production release by the manufacturer.
   3. The tool shall be licensed to the owner and shall not require annual license renewal fees.

K. Each IDC shall execute all application programs, calculations and commands via an integrated IO/32-bit minimum microcomputer resident in the panel. All data base for each panel and the operating system and all application programs for each panel shall be stored within the panel. The microcomputer shall permit floating point calculations to enable the performance of energy calculations. Each IDC shall contain a real-time clock to enable the panel to automatically perform time-based functions.

L. Each IDC shall be capable of full operation either as a completely independent panel or as part of the building wide control system. All panels shall contain the necessary equipment for direct interface to the sensors and actuators connected to it. The SCP network shall be able to detect changes in any IDC panel point status and report this change to the NAC.

M. Failure of any IDC on the system shall not affect the proper operation of the remaining system components.

N. Surge transient protection shall be provided for each IDC for the purpose of suppressing induced voltage transients.

O. In the event of a power outage or controller reset, each IDC shall enter a preprogrammed state on power re-application. Upon application of power to the IDC, all control conditions will start from an 'off' / 'closed' position or the default state. This state will be maintained for an automatically adjusted amount of time. Once this time delay has passed, the IDC control sequence shall resume according to current values.

P. All IDC's shall be provided with a communications port to allow connection of any industry standard laptop PC and custom configuration tool. Program access via this communications port allows direct field modification of the configuration parameters.

Q. Each IDC shall be listed under UL 916 (Energy Management Systems) and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.

R. Each IDC shall incorporate into its planning enough physical and logic accommodation for an increase of 20% future growth. In addition, all processes shall allow for point expansion to this increase during vendor startup should the need arise. Spare point capacity shall be provided for each I/O point type (AI, BI, AO, BO) proportional to their I/O point totals per SCP.

S. Each IDC shall accept digital (ON/OFF) and analog (temperature, valve position, etc.) feedback so that building equipment operation can be verified.

2.05 APPLICATION SPECIFIC CONTROLLER (ASC)

A. Each terminal unit shall have an Application Specific Controller (ASC) designed to provide the specified sequences. The controller shall store all specific control sequences and program settings in nonvolatile memory.

B. ASCs shall be microprocessor based interoperable controllers. All Interoperable Digital Controllers shall bear the applicable interoperability logo on each product delivered if so certified.

C. Each ASC shall perform all intended temperature control functions in a ‘standalone’ mode should the unit incur a loss of communications.

D. The complete ASC including accessory devices such as relay, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

E. All ASC’s shall be provided as self-sufficient units to maximize reliability and shall include internal ‘soft’ clock, operating systems, communication timing and interrupt controls, and shall be suitable for the specified applications.

F. Digital Inputs
   1. All digital inputs shall be over voltage protected.
   2. Digital input types supported by the CU:
      a. Normally open contacts (24V and 120V).
      b. Normally closed contacts (24V and 120V).
      c. Current/no current.
      d. Voltage/no voltage.
      e. Pulse/Totalizer contacts.

G. Digital Outputs
   1. All digital outputs shall be 24-volt AC, current sinking, 0.5 amp opto-isolated triacs.
   2. Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-slow-off) and 2-mode control.

H. Analog Inputs
   1. All analog inputs shall be over voltage protected.
   2. The analog to digital resolutions shall be a minimum of 10 bit.
   3. Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm thermistor, or 1K Ohm RTD.
   4. Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-10Vdc, etc.

I. Analog Outputs
   1. The ASC shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated.

2. All analog outputs shall be proportional current or voltage type.
3. The digital to analog resolution shall be a minimum of 10 bit.
4. Outputs shall be configurable so that 0-100% output commands can represent any portion of the output voltage/current range.
5. Outputs shall be reversible so that an increasing output command yields a decreasing electrical signal.

J. The following modes of control shall be incorporated into each ASC:
1. Occupied shall be a mode designed for normal occupied control of an area during regular business hours. This mode shall have unique heating and cooling set points associated with it.
2. Unoccupied shall be a mode designed for after-hours control of an area. This mode shall have unique heating and cooling set points associated with it.
3. Override shall be a mode designed to invoke normal occupied control during after-hours of an area. This mode shall use the occupied heating and cooling set points.
4. Economy shall be a mode designed for normal occupied times when energy demand usage is high and control set points need to be adjusted for lower energy use. This mode shall have unique heating and cooling set points associated with it.
5. Morning Warm-Up on units with an outdoor air economizer shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied set points but it will prevent outdoor air from entering the space. The outdoor air will move to its minimum position once the morning warm-up mode is over and the occupied mode is activated.
6. Morning Warm-Up on VAV units shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied set points but it will prevent the VAV box from maintaining a minimum air flow until the morning warm-up mode is over and the occupied mode is activated.
7. VAV box ASC's shall have an integral damper actuator and shall be the manufacturer's standard VAV box controller.
8. It shall be the responsibility of the Division 23 Mechanical contractor to verify that VAV box controllers will physically fit into the VAV box controls enclosure, and that the controllers can register the expected minimum and maximum flow rates utilizing the flow probe provided by the VAV box manufacturer.
   a. Acceptable Manufacturers
      1) Distech – BACnet/IP
      2) Easy I/O FG-Series – BACnet/IP
      3) Distech – BACnet MS/TP

2.06 PROGRAMMABLE CONTROL UNITS (PCU'S)

A. A BACnet™ based DDC Programmable Control Unit (PCU) shall be provided where required to perform the sequence of operation. The PCU shall be fully programmable by the programming tool. The controller shall be store all specific control sequences and program settings in non-volatile memory.

B. PCU controllers shall be microprocessor based interoperable controllers. All Interoperable Digital Controllers shall bear the applicable interoperability logo on each product delivered if so certified.

C. Each PCU shall perform all intended temperature control functions in a 'standalone' mode should the unit incur a loss of communications.

D. The complete PCU including accessory devices such as relay, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

E. All PCU's shall be provided as self-sufficient units to maximize reliability and shall include internal 'soft' clock, operating systems, communication timing and interrupt controls, and shall be suitable for the specified applications.

F. In the event of a power outage or controller reset, each PCU shall enter a preprogrammed state on power re-application. Upon application of power to the PCU, all control conditions will start from an 'off' / 'closed' position or the default state. This state will be maintained for an automatically adjusted amount of time. Once this time delay has passed, the PCU control sequence shall resume according to current values

G. All PCU's shall be provided with a communications port to allow connection of any industry standard laptop PC and custom configuration tools. Program access via this communications port allows direct field modification of the configuration parameters.

H. Digital Inputs
1. All digital inputs shall be over voltage protected.
2. Digital input types supported by the CU:
   a. Normally open contacts (24V and 120V).
   b. Normally closed contacts (24V and 120V).
   c. Current/no current.
   d. Voltage/no voltage.
   e. Pulse/Totalizer contacts.

I. Digital Outputs
1. All digital outputs shall be 24-volt AC, current sinking, 0.5 amp opto-isolated triacs.
2. Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-slow-off) and 2-mode control.

J. Analog Inputs
1. All analog inputs shall be over voltage protected.
2. The analog to digital resolutions shall be a minimum of 10 bit.
3. Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm thermistor, or 1K Ohm RTD.
4. Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-10Vdc, etc.

K. Analog Outputs
1. The PCU shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs shall be accommodated.
2. All analog outputs shall be proportional current or voltage type.
3. The digital to analog resolution shall be a minimum of 10 bit.
4. Outputs shall be configurable so that 0-100% output commands can represent any portion of the output voltage/current range.
5. Outputs shall be reversible so that an increasing output command yields a decreasing electrical signal.

L. PCU Control Modes

The following modes of control shall be incorporated into each PCU:
1. Occupied shall be a mode designed for normal occupied control of an area during regular business hours. This mode shall have unique heating and cooling set points associated with it.

2. Unoccupied shall be a mode designed for after-hours control of an area. This mode shall have unique heating and cooling set points associated with it.
3. Override shall be a mode designed to invoke normal occupied control during after-hours of an area. This mode shall use the occupied heating and cooling set points.
4. Economy shall be a mode designed for normal occupied times when energy demand usage is high and control set points need to be adjusted for lower energy use. This mode shall have unique heating and cooling set points associated with it.
5. Morning Warm-Up on units with an outdoor air economizer shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied set points but it will prevent outdoor air from entering the space. The outdoor air will move to its minimum position once the morning warm-up mode is over and the occupied mode is activated.
6. Morning Warm-Up on VAV units shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied set points but it will prevent the VAV box from maintaining a minimum air-flow until the morning warm-up mode is over and the occupied mode is activated.

M. Acceptable Manufacturers
1. Distech – BACnet/IP
2. Easy I/O FG-Series– BACnet/IP
3. Distech – BACnet MS/TP

2.07 SOFTWARE LICENSE AGREEMENT

A. The Owner shall sign or accept a copy of the IDC and NAC manufacturer's standard software and firmware licensing agreements as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

2.08 MATERIAL QUALITY ASSURANCE

A. The manufacturer of the IDC and NAC digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2.09 STAND ALONE CONTROL PANELS (SCP)

A. Furnish control panels of code gauge steel with locking doors for mounting all devices as shown. Panels shall conform to NEMA 1 standards, unless otherwise indicated.

B. Control panels shall meet all requirements of UL508A and shall be so certified and supporting documents provided.

C. Panels shall be constructed prior to delivery to site.

D. For each SCP provide a panel size sufficient for 20% growth of the I/O located within a specific SCP as it pertains to Division 23 Controls delivered I/O.

E. All external wiring shall be connected to terminal strips mounted within the panel.

1. Under no circumstances will field wiring be terminated from inputs or outputs direct to the I/O on the controllers. Further, all spare points meeting the 20% requirement will be pre-wired to terminal strips.

F. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels and the identification number of the panel.

G. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

H. Each panel shall have a pin-hinged door and master keyed lock.

I. Maximum panel depth no more than 9 inches.

J. Each panel shall be capable of proper operation in an ambient environment of 32 to 122 degrees F and 10% to 90% relative humidity

K. Each control panel (SCP) shall be provided with a minimum of one network switch (4 or 5 port) with one port available for local access to entire system from a service laptop if the control device(s) located in the SCP communicate over an IP network.
   1. Managed switches, switches larger than five ports or switches utilized for other resources other than those associated with the BMS shall be provided by others.
   2. Switches housed in SCPs supporting NACs or other Division 23 Controls provided BAS supporting devices shall be provided by the Division 23 contractor.

L. Each switch provided by the Division 23 Controls contractor shall terminate on a dedicated port on a building wide LAN/WAN switch provided by others. SCP housed switches shall not be cascaded or daisy chained.

PART 3 – DIVISION OF WORK

3.01 OVERVIEW

A. The Division 23 Controls/DDCS Contractor shall be responsible for all field controllers (IDC: ASC, PCU) - when not provided by packaged/factory controls - control devices, sensing devices, control panels, controller programming, and controller programming software.

B. The Division 23 (Mechanical) Contractor shall be responsible for all controller input/output wiring, power wiring (120VAC and other), interlock and safety wiring, controller network wiring, Ethernet LAN wiring as it pertains to NAC drops or other BMS attached devices, controller I/O wiring, wiring between non-HVAC sub systems and the BMS, all terminations, installation of BACnet MS/TP communication or other communication wiring to the NACs, installation of all control panels (including the Division 25 control panels), installation of all control devices, installation of all wiring as well as commissioning and point to point checkout as it pertains to components/systems identified under Division 23. The Division 23 Controls Contractor shall provide stand-alone controls for the MDF room. The controls shall control the MDF rooftop units, humidifier, de-humidifier, isolation dampers, exhaust fan, and monitor all related sensors as described in the sequences and mechanical drawings. A HMI shall be provided to allow for local operation of the MDF room controls including setpoint adjustment and lead/lag unit selection. The provided controls for the MDF room shall be monitored by the BMS via BACnet IP or BACnet MS/TP.

C. The Division 25 System Integrator (SI) shall be responsible for the Network Area Controller(s) (NAC), NAC control panels, providing communication (BACnet MS/TP and/or Modbus RTU) cable, providing Ethernet patch cables, software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, set up of schedules, trend logs and alarms, network management, global

supervisory control applications, system integration, coordination of the NAC to the local or wide area network as well as commissioning and point to point check as it pertains to deliverables identified under Division 25. The SI will also be responsible for overseeing point to point check out of the Division 23 deliverables in coordination with and support of the Division 23 contractor to include but not limited to the GUI and global control applications.

D. Divisions 23, 25 & Client Responsibility Table

Items/Task	**Div 23 (Mech)**	**Div 23 (Control)**	**Div 25**	[redacted]
Network Area Controllers/Panels (SCP)			X	
Interoperable Digital Controllers/Panels (SCP)			X	
Installation of IDC & NAC panels	O	X		
Sensors and Control Devices		X		
Installation of Sensors and Control Devices	X			
Application specific controller programming (IDCs)		X		
Global logic/NAC programming			X	
IDC/NAC Integration		O	X	
Factory supplied controller configuration		X	O	
Factory supplied controller integration			X	
Graphics			X	
IDC, NAC, field device terminations/connections	X			
MDF Room temperature and humidity control with HMI	O	X		
IP Addresses				X
Server and switch gear hardware specifications				X
Server hardware procurement				X
Switch gear (>5port or managed) hardware procurement				X
Switch gear (4-5 port, located within Div 23 – SCPs)		X		
Switch gear (4-5 port, located within Div 25 – SCPs)			X	
Electrical wiring (120VAC and other)	X			
Ethernet wiring (controller/device) drops	X			
Ethernet (LAN/WAN) & infrastructure				X
BACnet IP and Modbus TCP/IP wiring	X			
BACnet MS/TP trunk wiring (IDCs, NACs, factory controls)	X			
Modbus RTU trunk wiring (IDCs, NACs, factory controls)	X			
LonTalk trunk wiring (IDCs, NACs, factory controls)	X			
Sub-system wire drops and termination to BAS	X		O	
Workstations & Monitors				X
Operator system training		O	X	O
Complete point to point checkout of IDCs		X		
Complete point to point checkout of factory provided controls		O	X	
Overall system verification		O	X	O
X = Responsible O = Participate				

E. Work by Others

1. The demarcation of work and responsibilities between the Division 23 Contractor and other related trades shall be as outlined in the BMS Responsibility Matrix.

2. BMS Responsibility Matrix (below):

WORK	FURNISH	INSTALL	Low Volt. WIRING (24VDC or less)	LINE POWER (120V or greater)
BAS low voltage wiring	23	23	23	N/A
BAS communication wiring (BACnet MS/TP or Modbus)	25	23	23	N/A
BAS conduits and raceway	23	23	23	26
Automatic dampers	23	23	N/A	N/A
Manual valves	23	23	N/A	N/A
Automatic valves	23	23	23	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	23	23	23	26
BAS Current Switches	23*	23	23	N/A
BAS Control Relays	23*	23	23	N/A
Power distribution system monitoring interfaces	26	26	23	26
IDCs, equipment, housings, enclosures and panels	23/25	23	23	26
NACs and panels (Requires dedicated 120V circuit)	25	23	23	26
Smoke Detectors	26	26	26	26
Fire/Smoke Dampers	23	23	23	26
Fire Dampers	23	23	N/A	N/A
Duct Detector	26	23	26	26
VFDs	23	26	23	26
Fire Alarm shutdown relay interlock wiring	26	26	26	26
Fire Alarm smoke control relay interlock wiring	26	26	23	26
Fireman's Smoke Control Override Panel	26	26	26	26
Fan Coil Unit controls	23	23	23	26
Packaged RTU space mounted controls	23	23	23	26
Packaged RTU factory-mounted controls	23	23	23	26
Packaged RTU field-mounted controls	23	23	23	26
Starters, HOA switches, Starter heaters	26	26	N/A	26
Control damper actuators	23*	23	23	26
Generator Modbus	26	26	23	26
Lighting Relay Panels	26	26	23	26
Divisions: 23 – HVAC (23* - Controls) 25 – Integrated Automated System 26 – Electrical				

F. Documentation required by Division 23

1. The DDCS Contractor shall provide catalog data sheets, wiring diagrams and point lists to the Division 25 MSI for proper coordination of work. The points list shall be in spreadsheet format (Microsoft Excel) and include the following:

   a. BACnet Points: point/object name as used by the system, the object/point type; i.e. analog, binary, input, output, etc., the point/object description; i.e., what it is, and the data structure type; i.e. Boolean, integer, floating point, etc. The manufacturer's published BACnet PICS and BIBB statements shall be provided to the Division 25 System Integrator for each controller defining the programming or setup of each device. The DDCS Contractor shall provide all programming and documentation necessary to set up and configure the supplied devices per the specified sequences of operation.

1) For each BACnet device, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet or MS/TP.

b. Modbus Points: point/object name as used by the system, point object description, node address/register for each point including scaling or offset information for each point. The DDCS Contractor shall provide all programming and documentation necessary to set up and configure the supplied devices per the specified sequences of operation.

2. A Client standard naming/tagging convention shall be utilized for this project. A copy of the standard naming convention shall be provided prior to the start of the project and shall be utilized by the Division 23 contractor.
3. Network requirements as it pertains to LAN/WAN switch ports, static IP addresses, software ports and any other network items provided by others but required for a properly functioning BMS.
4. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.
5. Provide the Division 25 integrator a copy of all design documents and submittals in electronic format – AutoCAD™ version 2007 or later or Visio™ version 2003 or later, Microsoft Word and Microsoft Excel files.
6. Points list provided to the Division 25 SI. See last section of this specification.

PART 4 – IMPLEMENTATION REQUIREMENTS

4.01 OVERVIEW

A. The local BMS shall directly control HVAC equipment as specified in Section 23 09 93 - Sequence of Operations for HVAC Controls.

B. The local BMS shall provide monitoring of CO2 levels at selected locations for use in conjunction with temperature/RH sensors to calculate the heat index. CO2 sensor coverage is based generally on square footage; guidelines for placement are as follows.

1. One minimum of one sensor shall be provided for each zone of major occupancy or per air handling device
2. If a number of devices serve a large zone (warehouse space), sensors are to be spaced to provide a maximum coverage of 65,000 sq. ft. If occupancy density/patterns/usage is different in two adjacent areas, each area shall be considered a separate zone.
3. Where Demand Controlled Ventilation (DCV) is scheduled, CO2 levels shall be monitored at all times, with RTU control based on the highest CO2 level or occupancy zone, not average.
4. Ventilation in the office space shall be maintained per Code.

C. The local BMS shall provide combination temperature/humidity sensors, installed in the Warehouse areas as shown on the Mechanical drawings and/or spaced on approximately 300 foot centers (45,000 s.f. coverage). Sensors shall be placed 1 per 300ft and have system interface to all points for monitoring purposes including all graphics, programming, trending, alarms, and commissioning. No control strategy is provided; provide web interface to all points for monitoring purposes including all graphics, programming, trending, alarms, and commissioning, eg Air Rotation Units, Gas fired furnaces.

D. The local BMS shall provide flow monitoring of the domestic water main. Flow meter shall be turbine meter, equal to Elster T4000 or equivalent with pulse/analog converter. Size to be confirmed with water piping design documents. Piping and installation of meter shall

be by others. Provide communication wiring, web interface to all points, graphics, programming, trending, alarms, and commissioning.

E. The local BMS shall provide flow monitoring of the natural gas main. Flow meter shall be flanged turbine or ultrasonic meter. Meter size to be confirmed with gas piping design. Piping and installation of meter shall be by others. Provide communication wiring, web interface to all points, graphics, programming, trending, alarms, and commissioning.

F. The local BMS shall use the BACnet protocol for communication to the web server and for communication between control modules. I/O points, schedules, set points, trends, and alarms specified in Section 23 0993 – "Sequence of Operations for HVAC Controls" shall be BACnet objects.

G. The local BMS shall include outdoor weather station to gather OA conditions to be linked into BMS. The weather station shall be positioned remote from the HVAC and exhaust equipment, away from direct reflective surfaces and direct sunlight, which may distort data quality.

H. The local BMS shall include a building static pressure differential sensor to monitor building pressure as it relates to outdoors.

I. The local BMS shall monitor the temperature and relative humidity of all IDF rooms.

J. HVAC Equipment shall include a factory mounted DDC controller capable of communicating through BACnet the I/O points list specified in Section 23 09 93.

4.02 APPROVED CONTROL SYSTEMS

A. Use control system hardware and software that meet the requirements of this specification. Approved manufacturers are: Niagara N4, Distech, Easy I/O FG Series.

4.03 QUALITY ASSURANCE

A. Installer and Manufacturer Qualifications
   1. Installer shall have an established working relationship with above OEMs and their respective BMS and DDC Controls to include interface with the Niagara N4 architecture, network solutions. Installer shall be proficient in BACnet system integration.
   2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
   3. The manufacturer of the IDC and NAC digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.
   4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Final approval of installer shall be by Client Construction Manager.

PART 5 – CODES AND STANDARDS

5.01 OVERVIEW

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
   1. National Electric Code (NEC)
   2. International Building Code (IBC)
      a. Section 719 Ducts and Air Transfer Openings
      b. Section 907 Fire Alarm and Detection Systems
      c. Section 909 Smoke Control Systems
      d. Chapter 28 Mechanical
   3. International Mechanical Code (IMC)

PART 6 – SYSTEM PERFORMANCE

6.01 OVERVIEW

A. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.

B. Performance. OEM Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

C. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

D. Control Stability and Accuracy. Control loops shall be capable of maintaining measured variable set points within tolerances listed in Table 2. (select offset consistent with efficiency controlling building comfort.)

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

6.02 SUBMITTALS

A. Product Submittal Requirements: Meet requirements of Section 01 3000 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals within 12 weeks of contract award on the following:

B. BMS and Direct Digital Control (DDC) System Hardware
   1. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
   2. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
      a. Direct digital controllers (controller panels)
      b. Transducers and transmitters
      c. Sensors (include accuracy data)
      d. Actuators
      e. Valves
      f. Relays and switches
      g. Control panels
      h. Power supplies
      i. Batteries
      j. Operator interface equipment
      k. Wiring
   3. Wiring diagrams and layouts for each control panel. Show termination numbers.
   4. Floor plan schematic diagrams indicating field sensor and controller locations.
   5. Riser diagrams showing control network layout, communication protocol, and wire types.
   6. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

7. Network riser diagrams of wiring between central control unit and control panels.

C. Controlled Systems
1. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
3. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
4. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
5. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in Section 23 0993. Indicate alarmed and trended points.

D. Description of process, report formats, and checklists to be used in Section 23 0923 Article 3.17 (Control System Demonstration and Acceptance).

E. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

6.03 SCHEDULES

A. Schedule of work provided within one month of contract award, indicating:
1. Intended sequence of work items
2. Start date of each work item
3. Duration of each work item
4. Planned delivery dates for ordered material and equipment and expected lead times
5. Milestones indicating possible restraints on work by other trades or situations

B. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

6.04 PROJECT RECORD DOCUMENTS:

Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

A. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.

B. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 0923 Article 3.17 (Control System Demonstration and Acceptance).

C. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following.
1. As-built versions of submittal product data.
2. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
3. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

4. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
5. Documentation of programs created using custom programming language including set points, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, set points, tuning parameters, and objects can be viewed using furnished programming tools.
6. List of recommended spare parts with part numbers and suppliers.
7. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including equipment and sensors.
8. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
9. Licenses, guarantees, and warranty documents for equipment and systems.
10. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

6.05 TRAINING MATERIALS

Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.

PART 7 – WARRANTY

7.01 Warrant work as follows:

A. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

C. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.

D. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

E. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

PART 8 – OWNERSHIP OF PROPRIETARY MATERIAL

8.01 Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

A. Graphics
B. Record Drawings
C. Database
D. Application programming code
E. Documentation

PART 9 – COMMUNICATION

9.01 OVERVIEW

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet network. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.

B. Install new wiring and network devices as required to provide a complete and workable control network. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

D. Network operator interface and value passing shall be transparent to network architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each network controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each network controller.
2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the network. Program and test all cross-controller links required to execute control strategies specified in Section 23 0993. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the network. If applicable, system shall automatically adjust for daylight saving and standard time.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

9.02 CONTROLLER SOFTWARE

A. Building and energy management application software shall reside and operate in the Niagara N4 NAC (provided by the Div 25). Individual unit software shall reside in the factory installed DDC controller as a Product Integrated Controller (PIC).

B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.15.c (Operator Activity).

C. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93 - Sequence of Operations for HVAC Controls.

D. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled

variable, set point, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

E. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

F. Energy Calculations.
1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

G. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

H. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and set point.

I. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 0993 - Sequence of Operations for HVAC Controls.

9.03 CONTROLLERS

A. BACnet Communication.
1. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
2. BACnet routing shall be performed by NACs or other BACnet device routers as necessary to connect BCs to networks of ASCs.
3. Each ASC shall reside on a BACnet network using the MSTP Data Link/Physical layer protocol.

B. Communication.
1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

C. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

D. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

E. Serviceability.

1. Controllers shall have diagnostic LEDs for power, communication, and processor.
2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

F. Memory
1. Controller memory shall support operating system, database, and programming requirements.
2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

G. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

H. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

9.04 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

F. Binary Outputs. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

9.05 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish overcurrent protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and overcurrent protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
   a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
   b. Line voltage units shall be UL recognized and CSA listed.

9.06 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
   a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
   b. Other modulating dampers shall be opposed-blade.
   c. Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
2. Frame. Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminum with reinforced corner bracing.
3. Blades. Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s [2000 fpm]) performance. Blades shall be not less than 1.5875 mm (16 gauge).
4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m ^{2} (10 cfm per ft^2) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
6. Sections. Damper sections shall not exceed 125 cm - 150 cm (48 in. - 60 in.). Each section shall have at least one damper actuator.
7. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.

C. Temperature Sensors.
1. Sensors should be integral Temperature/RH sensors (T/H) with a battery life of not less than 10 years.
2. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
3. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m2(10 ft2) of duct cross-section.
4. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
5. Space Sensors. Space sensors shall have set point adjustment, override switch, display, and communication port as shown.
6. Differential Sensors. Provide matched sensors for differential temperature measurement.
7. Duct and room T/H sensors shall have a sensing range of 20%-80%.
8. Duct sensors shall have a sampling chamber.
9. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°C-75°C (40°F-170°F).
10. T/H sensors shall not drift more than 1% of full scale annually.

D. Relays
1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from set point shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

E. Override Timers
1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

F. Current Transmitters
1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

G. Current Transformers
1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

H. Voltage Transmitters
1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

I. Voltage Transformers
1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

J. Power Monitors
1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

K. Current Switches
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

L. Pressure Transducers
1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

M. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

N. Local Control Panels
1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

9.07 WIRING AND RACEWAYS

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

9.08 FIBER OPTIC CABLE SYSTEM

A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

C. CAT5,5e,6 and fiber must be installed by an Client IT approved contractor

PART 10 – EXECUTION

10.01 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.

B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 0923 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

10.02 PROTECTION

A. DDCS Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.

B. DDCS Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

10.03 COORDINATION

A. Site:
1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 23 0923 Article 1.10 (Submittals).

C. Test and Balance.
1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.

4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

D. Life Safety
1. Duct smoke detectors required for air handler shutdown are provided under Division 28 (unless noted otherwise on the drawings). Interlock smoke detectors to air handlers for shutdown as specified in Section 23 0993 - Sequence of Operations for HVAC Controls.

E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
1. Communication media and equipment shall be provided as specified in Section 23 0923 Article 2.2 (Communication).
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described in Section 23 0993 Appendix A regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

10.04 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

10.05 FIELD QUALITY CONTROL

A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 0923 Article 1.8 (Codes and Standards).

B. Continually monitor field installation for code compliance and workmanship quality.

C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

10.06 WIRING

A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 0923 differ from Division 26, Section 23 0923 shall take precedence.

B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.

C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.

D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.

E. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.

F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

G. Do not install wiring in raceway containing tubing.

H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.

I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.

J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.

K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.

L. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

M. Use color-coded conductors throughout.

N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.

P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.

Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.

R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.

S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.

T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

10.07 COMMUNICATION WIRING

A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).

B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.

D. Verify entire network's integrity following cable installation using appropriate tests for each cable.

E. Install lightning arrester according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.

F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.

G. Label communication wiring to indicate origination and destination.

H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

I. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
   1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
   2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
   3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
   4. An MS/TP EIA-485 network shall have no T connections.

10.08 FIBER OPTIC CABLE

A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. Install cabling and associated components according to manufacturer's' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

10.09 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment. Label/number each sensor so that in the event a sensor is dislodged, it can be located and reinstalled accurately.

C. Install room temperature sensors on concealed junction boxes properly supported by wall framing. For operational purposes, within the warehouse sensors should be mounted seven feet from the ground.

D. The local BMS shall provide monitoring of CO2 levels at selected locations for use in conjunction with temperature/RH sensors to calculate the heat index. CO2 sensor coverage is based generally on square footage; guidelines for placement are as follows.
   1. One sensor should be used for each zone of major occupancy or per air handling device
   2. If a number of devices serve a large zone (warehouse spaces), sensors shall be spaced to provide a maximum coverage of 65,000 sq. ft. If occupancy density/patterns/usage is different in two adjacent areas, each area should be considered a separate zone.

3. Where Demand Controlled Ventilation (DCV) is scheduled, CO2 levels shall be monitored at all times with RTU control based on the highest CO2 level or occupancy zone, not average.

E. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

F. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

G. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft (0.3 m) of sensing element for each 1 ft2 (0.1m2) of coil area.

H. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

I. Install outdoor air temperature sensors on north wall at designated location with sun shield.

J. Differential Air Static Pressure.
1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
6. Mount gauge tees adjacent to air and water differential pressure taps. Install shutoff valves before tee for water gauges.

K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hardwired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

10.10 ACTUATORS

A. General. Mount actuators and adapters according to manufacturer's recommendations.

B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
4. Provide necessary mounting hardware and linkages for actuator installation.

C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.

10.11 WARNING LABELS

A. Affix permanent warning labels to equipment that can be automatically started by the control system.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

C A U T I O N

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before Servicing.

B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows.

C A U T I O N

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

10.12 IDENTIFICATION OF HARDWARE AND WIRING

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.

B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show instrument or item served.

D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.

F. Label room sensors related to terminal boxes or valves with nameplates.

G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

H. Label identifiers shall match record documents.

10.13 PROGRAMMING

A. Point Naming. Name points as shown on the equipment points list provided with each sequence of operation. See Section 23 09 93 (Sequences of Operation). If character limitations or space restrictions make it advisable to shorten the name, the abbreviations given in Appendix B to Section 23 09 93 may be used. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

B. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.

1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 0993. Program documentation or comment statements shall reflect language used in sequences of operation.
2. System Programming. Provide system programming necessary for system operation.

C. **CONTROL SYSTEM CHECKOUT AND TESTING**

D. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 0923.
2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks.
   a. Check each alarm with an appropriate signal at a value that will trip the alarm.
   b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
   c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

10.14 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.17 (Control System Checkout and Testing). Provide Client’s designated Mechanical Engineer with log documenting completion of startup tests.
1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
2. Demonstration shall follow process submitted and approved under Section 23 0923 Article 1.10 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
3. Demonstrate actual field operation of each sequence of operation as specified in Section 23 0993. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
4. Demonstrate compliance with Section 23 0923 Part 1 (System Performance).
5. Demonstrate compliance with sequences of operation through each operational mode.
6. Demonstrate complete operation of operator interface.
7. Demonstrate each of the following.

a. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a set point change representing an actuator position change of at least 25% of full range. Each sample's trend data shall show set point, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.

b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting set point, and status of set points and other affected equipment parameters.

c. Building fire alarm system interface.

d. Trend logs for each system. Trend data shall indicate set points, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 0993. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 15 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 0923 Article 2.3 Paragraph E.11 (Trend Configuration).

8. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 0923 Article 1.10 (Submittals).

10.15 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

10.16 TRAINING

A. Training will be jointly performed by the DDCS (Division 23 Controls) and SI (Division 25) contractors. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives.

1. Proficiently operate system
2. Understand control system architecture and configuration
3. Understand DDC system components
4. Understand system operation, including DDC system control and optimizing routines (algorithms)

5. Operate workstation and peripherals
6. Log on and off system
7. Access graphics, point reports, and logs
8. Adjust and change system set points, time schedules, and holiday schedules
9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
10. Understand system drawings and Operation and Maintenance manual
11. Understand job layout and location of control components
12. Access data from DDC controllers
13. Create and change system graphics
14. Create, delete, and modify alarms, including configuring alarm reactions
15. Create, delete, and modify point trend graphs and multi-point trend graphs
16. Configure and run reports
17. Configure and calibrate I/O points
18. Maintain software and prepare backups
19. Interface with job-specific, third-party operator software
20. Add new users and understand password security procedures

C. Divide presentation of objectives into three sessions (1-12, 13-22, and 23-24). Participants will attend one or more of sessions, depending on knowledge level required.
1. Day-to-day Operators (objectives 1-12)
2. Advanced Operators (objectives 1-12 and 13-22)
3. System Managers and Administrators (objectives 1-12 and 23-24)

D. Provide course outline and materials according to Section 23 0923 Article 1.10 (Submittals). Provide one copy of training material per student.

E. Instructors shall be factory-trained and experienced in presenting this material.

F. Perform classroom training using a network of working controllers representative of installed hardware.

PART 11 – POINTS LIST

11.01 SUMMARY

A. A points table (example below) shall be developed by the Division 23 Controls contractor for each system included in this project. The points shall be accessible from the Graphical User Interface (GUI) and/or the Web browser interface (WBI), supplied under Division 25. The supplier of the IDC devices shall ensure that the points listed in this table are accessible on their respective networks, by the Network Area Controller(s) (NAC).

B. <u>All points</u> shall be exposed at the IDC controller level using the BACnet IP or BACnet MSTP protocol and be discoverable by the NAC(s) or server level device. Where points are allowed to be exposed as modifiable they shall be programmed as such.

C. The point lists shall include the point/object name as used by the system, the object/point type; i.e. analog, binary, input, output, etc., the point/object description; i.e., what it is, and the data structure type; i.e. Boolean, integer, floating point, etc.

D. The Division 23 Controls contractor shall construct a separate matrix/table for each system controlled through the DDCS listing each point and point functionality using the abbreviations below.

System:	Device Address:							
Point Name	**Point Address**	**Point Description**	**D**	**M**	**A**	**L**	**S**	**GC**
Supply Fan Status	*BI-3*	*Fan current switch*	*x*			*x*		
Occupancy Mode	*BV-40*	*Schedule point*		*x*			*x*	

D = Display only
M = Modify value
A = Alarm
L = Log
S = Schedule
GC = Global supervisory control routine (such as demand limiting)

END OF SECTION

SECTION 23 0920
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. This specification is to cover a complete variable frequency motor drive (VFD) consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor.

1.02 QUALITY ASSURANCE

A. Referenced Standards

1. Institute of Electrical and Electronic Engineers (IEEE)
2. Standard 519-Latest Edition, IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
3. Underwriters Laboratories Inc.
   a. UL 508C
4. National Electrical Manufacturer's Association (NEMA)
   a. ISC 6, Enclosures for Industrial Controls and Systems
   b. ISC 7.0, AC Adjustable
5. IEC 16800 Parts 1 and 2

B. Qualifications

1. VFDs shall be UL Listed.
2. VFDs shall be CUL Listed or CSA Approved.

C. VFD shall be manufactured in an ISO 9002 certified facility.

D. VFD shall be manufactured in accordance with ISO 14001 (Environmental Management Standard).

E. VFD shall meet the following vibration test standards: IEC 60068-2-29; 60068-2-64; 60068-2-6.

1.03 SUBMITTALS

A. Submittals shall include the following information:
1. Outline dimensions
2. Weight
3. Compliance to IEEE 519 (latest edition) - Harmonic analysis for particular jobsite including total voltage harmonic distortion and total current distortion
   a. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519, Recommended Practice and Requirements for Harmonic Control in

Electric Power Systems. The acceptance of this calculation must be completed prior to VFD installation.

b. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFDs. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provider and the user.

c. If the voltage THD exceeds 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

d. All VFDs that will be requiring passive filters must integrate the drive and filter package in a single enclosure. Passive filter capacitor elements are to be wired in parallel to the VFD and must include an isolating contactor for filter drop-in and drop-out at (programmable) low frequency VFD operation. When bypasses are required the filter elements will not be installed in the bypassing circuit.

e. If Division 26 requires AFE filters at the switchgear, additional filtering or AFE filtering at the drives may not be required per IEEE519. Coordinate with Division 26 contractor.

1.04 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time, and expenses.

PART 2 - PRODUCTS

2.01 ADJUSTABLE FREQUENCY DRIVES

A. Manufacturers

1. Drives and all necessary controls, as herein specified shall be supplied by the drive manufacturer. Manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.
2. All drives on the project shall be by the same manufacturer.
3. Acceptable Manufacturers shall be: ABB, Emerson, Danfoss, Yaskawa, Siemens, Eaton or Square D.

B. General

1. Drives shall be designed specifically for variable torque applications.
2. The adjustable frequency drives shall be solid state, with a Pulse Width Modulated (PWM) output waveform.
3. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (unless located outdoors; a NEMA 3R enclosure shall be furnished), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device, or the VFD shall consist of Matrix technology, where the input power stage converts three phase AC line power directly into variable AC output. The Main circuit shall consist of a compact input filter and bidirectional IGBT's. The bidirectional switches are input devices that carry the full current of the drive.

4. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

C. Specifications for the 1 HP to 400 HP (550 HP w/o bypass) VFD at 480 Volts and 1 to 100 HP VFD at 230 Volts:

1. Input 440/460/480/500 VAC +/-10% (capable of operation to 624 VAC), 3-phase, 48 - 63 Hz or Input 208/220/230/240 VAC +/-10%, 3-phase, 48 - 63 Hz.
2. Output 0 - Input Voltage, 3-phase, 0 to 500 Hz for drives up to 75 HP; 0 to 120 Hz for drives over 75 HP. Operation above 60 Hz. shall require programming changes to prevent inadvertent high-speed operation.
3. Environmental operating conditions: 14 to 120°F (-10 to 50° C) @ 3 kHz switching frequency, 0 to 3,300 feet above sea level, less than 95% humidity, non-condensing.
4. Enclosure shall be rated UL Type 1.

D. All VFDs shall have the following standard features:

1. All VFDs shall have the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.
2. The VFD shall give the user the option of either 1) displaying a fault, 2) running at a programmable preset speed, 3) hold the VFD speed based on the last reference received, or 4) cause a Warning to be issued, if the input reference (4-20mA or 2-10V) is lost; as selected by the user. The VFD shall provide a programmable relay output for customer use to indicate the loss of reference condition.
3. The VFDs shall utilize plain English digital display (code numbers and letters are not acceptable). The LCD shall be backlit to provide easy viewing in any light condition. The contrast should be adjustable to optimize viewing at any angle. All set-up parameters, indications, faults, warnings and other information must be displayed in words to allow the user to understand what is being displayed without the use of a manual or cross-reference table. Keypad shall have a built-in time clock capable of month, day and time stamping faults.
4. The VFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time.
5. The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs shall count down on the display to warn an operator that a restart will occur.
6. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
7. The VFD shall be equipped with an automatic extended power loss ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Removing power from the motor is not an acceptable method of increasing power loss ride-through.
8. The customer terminal strip shall be isolated from the line and ground.

9. Pre-wired 3-position Hand-Off-Auto switch and speed potentiometer. When in "Hand," the VFD will be started, and the speed will be controlled from the speed potentiometer. When in "Off," the VFD will be stopped. When in "Auto," the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
10. The drive shall employ the following 3 current limit circuits to provide trip free operation:
    a. The Slow Current Regulation limit circuit shall be adjustable to 130% (minimum) of the VFDs variable torque current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
    b. The Rapid Current Regulation limit shall be adjustable to 170% (minimum) of the VFDs variable torque current rating.
    c. The Current Switch-off limit shall be fixed at 175% (minimum, instantaneous) of the VFDs variable torque current rating.
11. The overload rating of the drive shall be 110% of its variable torque current rating for 1 minute every 10 minutes, and 130% of its variable torque current rating for 2 seconds every 60 seconds.
12. The VFD shall have input line fuses or circuit breakers standard in the drive enclosure.
13. The VFD shall have a DC Line Reactor to reduce the harmonics to the power line and to increase the fundamental power factor. Dual DC link chokes may be utilized as an acceptable alternate.
14. The VFD shall be optimized for a 4 kHz carrier frequency to reduce motor noise and provide high system efficiency. Carrier frequency shall be selectable for 1, 2, 4, 8, 10, or 12 kHz.
15. The VFD shall include a fireman's override input. This mode shall override all other control modes (analog, digital, serial and keypad commands) and the motor shall run at the preprogrammed speed. The keypad shall display "Override Mode" status. Upon removal of the override signal, normal operation shall be resumed.

E. All VFDs shall have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
2. PI Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.
3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PI controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 mA and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz.
4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. One (1) digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock), drive is to resume normal operation.
5. Two (2) programmable analog outputs proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, or Active Reference.

6. Three (3) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs must be true form C type contacts; open collector outputs are not acceptable.
7. Seven (7) programmable preset speeds.
8. Two (2) independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1,800 seconds.
9. The VFD shall Ramp or Coast to a stop, as selected by the user.

F. The following operating information displays shall be standard on the VFD digital display. The display shall be in complete English words (alpha-numeric codes are not acceptable).

1. Output Frequency
2. Motor Speed (RPM, % or Engineering units)
3. Motor Current
4. Calculated Motor Torque
5. Calculated Motor Power
6. DC Bus Voltage
7. Output Voltage
8. Heatsink Temperature
9. Analog Input Values
10. Keypad Reference Values
11. Elapsed Time Meter
12. kWh meter

G. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alpha-numeric codes are not acceptable).

1. Overcurrent trip 175% instantaneous of the VFDs variable torque current rating.
2. Overvoltage trip 130% of the VFDs rated voltage
3. Under voltage trip 65% of the VFDs rated voltage
4. Over temperature +176-194°F (+80-90°C)
5. Ground Fault either running or at start
6. Adaptable Electronic Motor Overload (I2t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits which are not speed dependent are unacceptable. The electronic motor overload protection shall be UL Listed for this function.

H. Speed Command Input shall be via:

1. Keypad.
2. Two (2) analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal. Input shall be isolated from ground, and programmable via the keypad for different uses.
3. Analog inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from 0.01 to 10 seconds. The analog input should be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 mA and 0 - 10 Volts. The active analog input shall have loss of reference protection, if selected.

4. Floating point input shall accept a 3-wire input from a Dwyer Photohelic (or equivalent type) instrument.

I. Serial Communications

1. The VFD shall have embedded Modbus RTU, BACnet, Siemens FLN and Johnson Metasys N2 protocols as standard for building automation systems network communications accessible via a RS-485 port.
2. Optional protocols shall include LonWorks, and Ethernet.
3. The VFD shall be able to communicate with PLCs, DCSs, and DDCs.
4. Serial communication capabilities shall include, but not be limited to, run-stop control, speed set adjustment, proportional/integral PI controller adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the Building Automation System (BAS) to monitor feedback such as output speed/frequency, current (in amps), % torque, % power, kilowatt hours, relay outputs, and diagnostic fault information.

J. Accessories to be Furnished and Mounted by the Drive Manufacturer

1. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external interlocks and start/stop contacts shall remain fully functional whether the drive is in Hand, Auto or Bypass.
2. All wires to be individually numbered at both ends for ease of troubleshooting.
3. Door interlocked thermal magnetic circuit breaker which will disconnect all input power from the drive and all internally mounted options. The disconnect handle shall be thru-the-door type, and be padlockable in the “Off” position.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

B. The manufacturer must ensure that the installed THD is less than 5%. Should the voltage THD exceed 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

C. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

1. VFD rated shielded cabling shall be provided between the drive and the motor.

D. When 6 pulse drives are used, provide dv/dt filters when the VFD is between 100 and 300 feet from the motor and provide sine wave filters when the VFD is over 300 feet from the motor.

3.02 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

3.03 TRAINING

A. The manufacturer shall provide on-site training for the Owner's maintenance personnel for a period of not less than four (4) hours. Training shall be provided for each different type of drive.

END OF SECTION

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SECTION 23 0993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 – GENERAL

1.01 OFFICE AREA ROOFTOP UNIT (Air Source Heat Pump)

Run Conditions - Scheduled:

The unit shall maintain:

- A 75°F (adj.) cooling setpoint
- A 68°F (adj.) heating setpoint.

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling set points at the BMS. Overrides will be reset back to specified defaults at the beginning of each day.

Return Air Smoke Detection:

The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

Emergency Shutdown:

The unit shall shut down and generate an alarm upon receiving a signal from the fire alarm system.

Supply Fan:

The supply fan shall run anytime there is a call for cooling and/or heating as well as to maintain building ventilation rates, unless shutdown on safeties. Continuous fan shall only be set on a predetermined number of units as required to maintain ventilation rates. To prevent short cycling, the supply fan shall have a factory defined minimum runtime.

Cooling Stages:

The controller shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. RTUs shall be equipped with an integrated economizer, where the economizer is the first stage of cooling and mechanical cooling engages to supplement the economizer. To prevent short cycling, there shall be a factory delay between stages, and each stage shall have a definable (minimum runtime.

The cooling shall be enabled whenever:

- The economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Heating Stages:

The controller shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a factory defined delay between stages, and each stage shall have a definable minimum runtime.

The heating shall be enabled whenever:

- The zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers to 100% open in sequence to maintain discharge air temp setpoint. The outside air dampers shall maintain a minimum adjustable position of 10% (adj.) open whenever occupied, unless CO2 levels exceed 1000ppm

The economizer shall be enabled whenever:

- Outside air temperature is less than 70°F (adj.).
- AND the outside air enthalpy is less than 22BTU/lb (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Minimum Outside Air Ventilation:

The outside air dampers shall maintain minimum scheduled values during building occupied hours and be closed during unoccupied hours. For systems specified with demand controlled ventilation (DCV), if ppm levels exceed 1000ppm outside air dampers will modulate to 20%, until satisfied, then back down to 10% or minimum scheduled values.

Supply Air Temperature:

The controller shall monitor the supply air temperature.

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control (if present).

Humidity Control:

The controller shall monitor the return and space humidity. The control shall lower the current cooling setpoint in one degree increments when the return humidity increases above the humidity setpoint.

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Zone Temp	×							×		×
Zone Setpoint Adjust	×									×
Outside Air Humidity	×							×		×
Outside Air Temp	×							×		×
Return Air Humidity	×							×		×
Return Air Temp	×							×		×
Supply Air Temp	×							×		×
Space Air Temp	×							×		×
Space Air Humidity	×							×		×
Return Air Smoke Detector			×					×	×	×

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Emergency Shutdown			×			×			×	×
Supply Fan Status			×					×		×
Supply Fan Start/Stop				×				×		×
Cooling Stage 1				×				×		×
Cooling Stage 2				×				×		×
Cooling Stage 3				×				×		×
Cooling Stage 4				×				×		×
Heating Stage 1				×				×		×
Heating Stage 2				×				×		×
Schedule										
Heating Setpoint								×		×
Cooling Setpoint								×		×
High Zone Temp									×	
Low Zone Temp									×	
Supply Fan Failure									×	
Supply Fan Runtime Exceeded									×	
Compressor Runtime Exceeded									×	
High Return Air Temp									×	
Low Return Air Temp									×	

1.02 WAREHOUSE ROOFTOP UNIT (Variable Refrigerant Volume Heat Pumps)

Run Conditions - Scheduled:

The unit shall maintain:

- A 75°F (adj.) cooling setpoint
- A 65°F (adj.) heating setpoint.

Zone Setpoint Adjust:

Zone temperature heating and cooling setpoints shall be adjustable at the BMS level only, with no occupant adjustment at the zone sensor. Overrides will be reset back to specified defaults at the end of each day.

Return Air Smoke Detection:

The unit shall shut down and generate an alarm upon receiving a duct smoke detector status.

Emergency Shutdown:

The unit shall shut down and generate an alarm upon receiving a signal from the fire alarm system.

Supply Fan:

The supply fan shall run anytime there is a call for cooling and/or heating as well as to maintain building ventilation rates unit is commanded to run, unless shutdown on safeties. Continuous fan should only be set on a predetermined number of units to maintain ventilation rates. To prevent short cycling, the supply fan shall have a factory defined minimum runtime.

Cooling Stages:

The controller shall measure the zone temperature and modulate the cooling to maintain its cooling setpoint. HRTUs shall be equipped with an integrated economizer, meaning that the economizer is the first stage of cooling and mechanical cooling engages to supplement the economizer. To prevent short cycling, there shall be a factory defined delay between stages, and each stage shall have a defined minimum runtime.

The cooling shall be enabled whenever:

- The economizer (if present) is disabled or fully open.
- AND the zone temperature is above cooling setpoint.
- AND the supply fan status is on.
- AND the heating is not active.

Heating Stages:

The controller shall measure the zone temperature and modulate the heating to maintain its heating setpoint. To prevent short cycling, there shall be a factory defined delay between stages, and each stage shall have a defined minimum runtime.

The heating shall be enabled whenever:

- The zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

Economizer:

The controller shall measure the zone temperature and modulate the economizer dampers to 100% open in sequence to maintain a discharge air temp setpoint. The outside air dampers shall maintain a minimum adjustable position of 10% (adj.) open whenever occupied, unless CO2 levels exceed 1000ppm.

The economizer shall be enabled whenever:

- Outside air temperature is less than 70°F (adj.).
- AND the outside air enthalpy is less than 22BTU/lb (adj.).
- AND the outside air temperature is less than the return air temperature.
- AND the supply fan status is on.

The economizer shall close whenever:

- Mixed air temperature drops from 45°F to 40°F (adj.).
- OR on loss of supply fan status.
- OR freezestat (if present) is on.

The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

Night Purge: If the average zone temp is greater than the min purge setpoint (60deg F) and Outside air heat index is 7 degrees F less than the average zone temp and Purge is enabled (24/7) and Outside air enthalpy is less than the enable setpoint (22btu) then Open dampers to 100%.

Minimum Outside Air Ventilation:

The outside air dampers shall maintain minimum scheduled values during building occupied hours and be closed during unoccupied hours. For systems specified with demand controlled ventilation (DCV), if ppm levels exceed 1000ppm outside air dampers will modulate to 20%, until satisfied, then back down to 10% or minimum scheduled values.

Return Air Temperature:

The controller shall monitor the return air temperature and use as required for economizer control (if present).

Supply Air Temperature:

The controller shall monitor the supply air temperature.

Humidity Control:

The controller shall monitor the return and space humidity. The control shall lower the current cooling setpoint in one degree increments when the return humidity increases above the humidity setpoint.

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Zone Temp	×							×		×
Zone Setpoint Adjust	×									×
Outside Air Humidity	×							×		×
Outside Air Temp	×							×		×
Return Air Humidity	×							×		×
Return Air Temp	×							×		×
Supply Air Temp	×							×		×
Zone Override										
Return Air Smoke Detector			×					×	×	×
Emergency Shutdown			×			×			×	×
Supply Fan Status			×					×		×
Supply Fan Start/Stop				×				×		×
Cooling Percent				×				×		×
Space Temp	×							×		×
Space Humidity	×							×		×
Cooling Stage 4				×				×		×
Heating percent				×				×		×
Heating Stage 2				×				×		×
Filter									×	×
Heating Setpoint								×		×
Cooling Setpoint								×		×
High Zone Temp									×	
Low Zone Temp									×	
Supply Fan Failure									×	
Supply Fan Runtime Exceeded									×	
Compressor Runtime Exceeded									×	
High Return Air Temp									×	
Low Return Air Temp									×	

1.03 EXHAUST FANS – ON/OFF:

Run Conditions - Scheduled:

The fan shall run according to a user definable schedule.

Fan:

The fan shall have a user definable (adj.) minimum runtime.

Fan Status:

The controller shall monitor the fan status.

Alarms shall be provided as follows:

- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.
- Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**
Fan Status			x						x	
Fan Start/Stop				x					x	
Schedule								x		
Fan Failure										x
Fan in Hand										x
Fan Runtime Exceeded										x

1.04 AIR PURGE SYSTEM:

ZONE 1: (GROUND LEVEL)

The exhaust fans(s) EFSP 1-1, EFSP 1-2, EFSP 1-3, EFSP 1-4, EFSP 1-5, and EFSP 1-6 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 1.

The HRTU(s) C-1, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9, C-10, C-11, E-1, E-2, E-3, E-4, E-5, and E-6 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 1. The Building Automation System (BAS) shall command the RTU(s) to start in the economizer mode with the return air damper fully closed, the outside air damper fully open, and the supply fan shall be commanded to run.

Dock door manual operation shall be noted for additional ventilation.

ZONE 2: (LEVEL TWO)

The exhaust fans(s) EFSP 2-1, EFSP 2-2, EFSP 2-3, EFSP 2-4 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 2.

The HRTU(s) A-1, A-2, A-3, A-4, A-5, A-6, A-7, A-8, A-9, A-10, A-11, A-12, A-13, and A-14 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 2. The Building Automation System (BAS) shall command the RTU(s) to start in the economizer mode with the return air damper fully closed, the outside air damper fully open (100%), and the supply fan shall be commanded to run.

The HRTU(s) associated supply air fire smoke damper(s) shall open on LEVEL 2 and close on LEVEL 3 and LEVEL 4. All remaining fire smoke damper(s), including return air, shall remain closed.

ZONE 3: (LEVEL THREE)

The exhaust fans(s) EFSP 3-1, EFSP 3-2, EFSP 3-3, EFSP 3-4 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 3.

The HRTU(s) A-1, A-2, A-3, A-4, A-5, A-6, A-7, A-8, A-9, A-10, A-11, A-12, A-13, and A-14 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 3. The Building Automation System (BAS) shall command the RTU(s) to start in the economizer mode with the return air damper fully closed, the outside air damper fully open (100%), and the supply fan shall be commanded to run.

The HRTU(s) associated supply air fire smoke damper(s) shall open on LEVEL 3 and close on LEVEL 2 and LEVEL 4. All remaining fire smoke damper(s), including return air, shall remain closed.

ZONE 4: (LEVEL FOUR)

The exhaust fans(s) EFSP 4-1, EFSP 4-2, EFSP 4-3, EFSP 4-4 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 4.

The HRTU(s) A-1, A-2, A-3, A-4, A-5, A-6, A-7, A-8, A-9, A-10, A-11, A-12, A-13, and A-14 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 4. The Building Automation System (BAS) shall command the RTU(s) to start in the economizer mode with the return air damper fully closed, the outside air damper fully open (100%), and the supply fan shall be commanded to run.

The HRTU(s) associated supply air fire smoke damper(s) shall open on LEVEL 4 and close on LEVEL 2 and LEVEL 3. All remaining fire smoke damper(s), including return air, shall remain closed.

ZONE 5: (LEVEL FIVE)

The exhaust fans(s) EFSP 5-1, EFSP 5-2, EFSP 5-3, EFSP 5-4, EFSP 5-5, and EFSP 5-6 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 5.

The HRTU(s) B-1, B-2, B-3, B-4, B-5, B-6, B-7, B-8, B-9, B-10, B-11, B-12, B-13, B-14, B-15, B-16, B-17, B-18, B-19, B-20, B-21, AND B-22 shall be enabled to run whenever a start signal is received from the Fire Alarm/Smoke Control Panel for Air Purge Zone 5. The Building Automation System (BAS) shall command the RTU(s) to start in the economizer mode with the return air damper fully closed, the outside air damper full open, and the supply fan shall be commanded to run.

1.05 BUILDING PRESSURE CONTROL:

Run Conditions - Interlocked:
The unit(s) EFSP shall be interlocked to run whenever receiving a high static signal form their associated static pressure sensor unless shutdown on safeties.

Ground Level: EFSP 1-1 and EFSP 1-3
Level Two: EFSP 2-1 and EFSP 2-4
Level Three: EFSP 3-1 and EFSP 3-4
Level Four: EFSP 4-1 and EFSP 4-4
Level Five: EFSP 5-1 AND EFSP 5-6

Control - Building Static Pressure:
The controller shall measure building static pressure and stage the exhaust fan on and off to maintain a building static pressure setpoint of 0.08in H_2O (adj.). The fan shall have a user definable (adj.) minimum runtime.

Alarms shall be provided as follows:

- High Building Static Pressure: If the building static pressure is 25% (adj.) greater than setpoint.
- Low Building Static Pressure: If the building static pressure is 25% (adj.) less than setpoint.

Fan Status:
The controller shall monitor the fan status.

Alarms shall be provided as follows:

- Fan Failure: Commanded on, but the status is off.
- Fan in Hand: Commanded off, but the status is on.
- Fan Runtime Exceeded: Fan status runtime exceeds a user definable limit (adj.).

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Building Static Pressure	×								×		×
Fan Status			×						×		×
Fan Start/Stop				×					×		×
Building Static Pressure Setpoint					×						×
Fan Failure										×	
Fan in Hand										×	
Fan Runtime Exceeded										×	
High Building Static Pressure										×	
Low Building Static Pressure										×	
Totals	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**3**	**5**	**4**

Total Hardware (3) **Total Software (9)**

1.06 ENERGY RECOVERY HEAT PUMP UNITS:

The ALC controller is turned on by a switch located on its front upper left corner. Several Occupancy Control options are available for starting the unit. These can be selected from the Equipment Interface on the Controls screen (requires user password). The Resident Program has an adjustable scheduler that uses the internal time clock to allow for separate Sequences for Occupied and Unoccupied periods. This can be accessed from the Equipment Interface on the Schedules screen (requires user password). NOTE: All temperature-related events have an additional 10 second (fixed) "delay on make" to allow temperatures to settle.

OCCUPIED MODE:

When the BAS calls for the start of the Occupied Mode, and the ALC controller has verified that there are no fault or shutdown conditions, after a 30-second (fixed) delay the unit goes into Occupied Mode:

1. Outdoor Air Damper (OD):
   - After the unit goes into Occupied Mode, the Outdoor Air (OA) damper will open. As the OA damper opens, the Outdoor Air Damper Actuator (OADA) auxiliary switches close.
   - The OA damper stays open until the system reaches the end of the Occupied Mode period. It will remain open until the supply fan turns off. After the supply fan turns off, the OA damper will close.

2. Supply Fan (SF):
   - As the OA damper opens, the OADA auxiliary switch will close and the SF will turn on.
   - The SF will run for 30 seconds (fixed) before cooling, dehumidification, or heating will be enabled.
   - The SF shall operate continuously while the unit is in the Occupied Mode. When the system reaches the end of the Occupied Mode period, the SF will continue to run for an additional 2 minutes before turning off.
   - SF-VSC: Supply Fan with Variable Speed Control.
     - The SF-VSC will modulate its speed based upon the SF Differential Pressure Transmitter (SF-DPT) signal and the supply duct static pressure set point.
     - Optional: For constant air volume (CAV), select "Manual Override" in the Equipment Interface and input the required speed (%) as determined in the field by Test and Balancing.

3. Exhaust Fan (EF):
   - At the same time the SF turns on, the EF will be enabled to run.
   - The EF shall be enabled to run while the unit is in the Occupied Mode. When the system reaches the end of the Occupied Mode period, the EF will be enabled to run for an additional 2 minutes before turning off.
   - EF-VSC: Exhaust Fan with Variable Speed Control.
     - If the Zone Differential Pressure Transmitter (ZN-DPT) signal is above the building static pressure set point, the EF-VSC will modulate its speed based upon the ZN-DPT and the set point. If the ZN-DPT signal is below the building static pressure set point, the EF will modulate down to 0% (adjustable) speed.
     - Optional: For constant air volume (CAV), select "Manual Override" in the Equipment Interface and input the required speed (%) as determined in the field by Test and Balancing.

4. Energy Conservation Wheel (ECW):
   - After the SF turns on, the ECW is enabled.

- ECW with VFD Controlled Defrost (WM-VFD):
  - When the OAT is 3°F (adjustable) or more above or below the RAT, the ECW will be on. It will be off if the OAT is less than 3°F (adjustable) above or below the RAT. If the WExAT goes below 25°F (adjustable), it will modulate speed down to 10 Hz (minimum, adjustable) to allow for wheel defrosting. It will increase speed as the WExAT rises toward 25°F (adjustable) or more.

5. Cooling Mode:
   - Reversing Valve is "OFF" in Cooling Mode.
   - Cooling Mode is available when the ECAT is 1°F (fixed) above the ECAT cooling lower limit (55°F, adjustable) and there is a demand for cooling.
   - When the ECAT is 1°F (adjustable) or more above the ECAT cooling set point #1 (70°F, adjustable), compressor #1 turns on.
   - When compressor #1 has been running for more than 10 minutes, the SAT is 2°F (adjustable) or more above the SAT cooling set point (70°F, adjustable), and compressor # 1 is above 95% capacity, compressor #2 turns on.
   - When the SAT is 2°F (adjustable) or more below the SAT cooling set point, compressor #2 turns off.
   - When the ECAT is 1°F (adjustable) or more below the ECAT cooling set point #1, compressor #1 turns off.
   - Factory suggested minimum SF-VSC modulation shall be 50% (adjustable).
   - Tandem Compressor: The lag circuit is enabled when the unloader switch is energized. The unloader switch is energized when the compressor suction pressure goes above the set point of 140psi (adjustable on the unloader switch). When the suction pressure goes below the set point minus a differential of 32psi (adjustable), the lag circuit turns off. A time delay module with a 5-minute (fixed) minimum run-time and 5-minute (fixed) minimum time-off delay is used to prevent compressor short cycling.
   - Compressor enabling logic includes a 5-minute (fixed) minimum run-time and a 5-minute (fixed) minimum time-off delay to prevent compressor short cycling.
   - Standard Lead Compressor with VFD:
     - The compressor will modulate based upon the Dx Leaving Air Temperature (Dx LAT) cooling set point (55°F, adjustable).
     - The compressor will ramp to 100% once an hour, for 60 seconds, to push oil back to the compressor. The hot gas reheat circuit and sub cooling circuits, if present, will be enabled for the duration of the oil purge.
   - If the Dx LAT drops to 38°F or less for 10 minutes, the ALC controller will issue an alarm and the compressor stops. When the Dx LAT warms back up to 55°F or more, the compressor turns back on.
   - If there is a current call for 1st stage cooling and compressor #1 is shut down due to an alarm (HPS1, LPS1, or Freeze Protection 1), compressor #2 will be turned on to take its place until it returns.
   - Hot Gas Reheat (HGRH) – Modulating:
     - When the SAT is 1°F (adjustable) or more below the SAT cooling set point (70°F, adjustable), HGRH turns on and modulates based upon the SAT cooling set point.
     - When SAT is 2°F (adjustable) or more above the SAT cooling set point, HGRH turns off.
     - If the HGRH is unable to maintain the SAT cooling set point, the compressor modulation will be increased to provide more capacity for reheat.

6. Dehumidification Mode:
   - Reversing Valve is "OFF" in Dehumidification Mode.
   - Dehumidification Mode is available if the ECAT is 1°F (fixed) above the dehumidification lower limit of 60°F (adjustable) and there is no call for heating.
   - When the Entering Coil Air Dew Point (ECDP) is 1°F (adjustable) or more above the Supply Air Dew Point (SADP) set point (55°F, adjustable), Dehumidification Mode is enabled. After the minimum time-off delay, compressor #1 turns on.
   - When the SADP is 2°F (adjustable) or more above the SADP set point, and after minimum time-off delay, compressor #2 turns on -- not less than 10 minutes (adjustable) after compressor #1 turned on.

- When the SADP is 1°F (adjustable) or more below the SADP set point, compressor #2 turns off.
- When the ECDP is 2°F (adjustable) or more below the SADP set point, compressor #1 turns off and Dehumidification Mode is disabled.
- Standard Lead Compressor with VFD:
  - The compressor will modulate based upon the SADP set point.
  - The modulation may be modified based upon the Dx Leaving Air Temperature (Dx LAT) middle freeze set point (45°F, adjustable) to provide freeze protection.
  - The compressor will ramp to 100% once an hour, for 60 seconds, to push oil back to the compressor. The hot gas reheat circuit and sub cooling circuits, if present, will be enabled for the duration of the oil purge.
- Hot Gas Reheat (HGRH) – Modulating:
  - When the SAT is 1°F (adjustable) or more below the SAT dehumidification set point (70°F, adjustable), HGRH turns on and modulates based upon the SAT dehumidification set point.
  - When SAT is 2°F (adjustable) or more above the SAT dehumidification set point, HGRH turns off.
  - If the HGRH is unable to maintain the SAT dehumidification set point, the compressor modulation will be increased to provide more capacity for reheat.
- Switchable Sub-Cooling:
  - When either of the compressors are enabled, the sub-cooling coil is enabled.
  - When both of the compressors are disabled, the sub-cooling coil is disabled.

7. Heat Pump Mode:
   - Reversing Valve is "ON" in Heating Mode.
   - Heat Pump Mode is available when the ECAT is 1°F (fixed) below the ECAT heating upper limit (60°F, adjustable) and there is a demand for heating.
   - When the ECAT is 1°F (adjustable) or more below the ECAT heating set point (55°F, adjustable), compressor #1 turns on.
   - When the SAT is 2°F (adjustable) or more below the SAT heating set point (70°F ,adjustable), compressor #2 turns on -- not less than 10 minutes (adjustable) after compressor #1 turned on.
   - When the SAT is 2°F (adjustable) or more above the SAT heating set point, compressor #2 turns off.
   - When the ECAT is 1°F (adjustable) or more above the ECAT heating set point, compressor #1 turns off.
   - Heat pump operation shall be disabled if the SF-VSC modulation drops below 85% (factory suggestion; adj.).
   - <u>Optional</u>: When enabled, if there is a call for 1st stage heating, 2nd stage heating will be enabled after a 10-minute (adjustable) delay. Default is "OFF".
   - Compressor enabling logic includes a 5-minute (fixed) minimum run-time as well as the 5-minute (fixed) minimum time-off delay to prevent compressor short cycling.
   - Standard Lead Compressor with VFD:
     - The compressor will modulate based on the SAT heating set point.
     - The compressor will ramp to 100% once an hour, for 60 seconds, to push oil back to the compressor.
   - If there is a current call for 1st stage heating and compressor #1 is shut down due to an alarm (HPS1, LPS1, or Freeze Protection #1), compressor #2 will be turned on to take its place until it returns.
   - Defrost Mode: On defrost mode, the reversing valve will switch to cooling to defrost the built-up ice on the outdoor coil.

- The unit is equipped with a Defrost Timer. The defrost timer provides a selectable time interval between defrost cycles. It will allow a 10 minute defrost every 30/60/90 minutes as long as the defrost thermostat is closed. The timer is factory set at 60 minutes. The time interval may be changed to 30 or 90 minutes if desired (disconnect power to the unit before moving the jumper). The hold input on the defrost timer allows the timer to accumulate time while the compressor is running in heating mode. A warm outdoor coil causes the defrost thermostat to open which will prevent time accumulation or end the Defrost period. The defrost timer allows up to a 10 minutes defrost cycle if the defrost thermostat is closed. When the defrost period ends, either by opening of the defrost thermostat or after the 10 minutes defrost period has elapsed, the timer is reset. By shorting the two test terminals together on the defrost timer, a 60 minute delay is reduced to 14 seconds and a 10 minute delay is reduced to 2.3 seconds for testing purposes.
- During defrost cycle, the auxiliary heat will energize based upon the SAT set point.

8. Auxiliary Heating Mode:
   - After both heat pumps have been enabled, when the SAT is 2°F (adjustable) or more below the SAT heating set point (70°F, adjustable), and after a 10-minute (adjustable) delay period, auxiliary heating will be enabled. When the SAT is above the SAT heating set point, auxiliary heating will be disabled.
   - Modulated Heat:
     - SCR Electric Heat: On demand for heating, the ALC controller modulates the electric heating SCR based upon the SAT heating set point (70°F, adjustable).

9. Emergency Heating Mode:
   - The Compressors are "OFF" in Emergency Heating Mode.
   - Emergency Heating mode is selectable using the Equipment Interface or Building Automation System (BAS) (default is “OFF”). Emergency Heating mode will automatically be turned on if both heat pump compressors fail or are disabled due to either the OAT going below the Compressor Disable set point of 26°F (adjustable) or the SF-VSC modulating below 85% (adjustable).
   - Emergency Heating Mode is available when the ECAT is 1°F (fixed) below the ECAT heating upper limit (60°F, adjustable) and there is a demand for heating.
   - When the ECAT is 1°F (adjustable) or more below the ECAT heating set point (55°F, adjustable), emergency heating is enabled.
   - When the ECAT is 1°F (adjustable) or more above the ECAT heating set point, emergency heating is disabled.
   - Modulated Emergency Heat:
     - SCR Electric Heat: On demand for emergency heating, the ALC controller modulates the electric heating SCR based upon the SAT heating set point (70°F, adjustable).

<u>UNOCCUPIED MODE</u>:

- When the Occupancy Control indicates the end of the Occupied Mode, the compressor(s) and outdoor fan(s) will turn off (subject to minimum run-time) or the heating system will turn off. The SF and EF will continue to run for 2 minutes before turning off.
- After this, the ECW will turn off and the OA damper will close. The unit is now off.

Safety Switches:

- High Pressure Switch (HPS1): If HPS1 is open, compressor #1 will turn off and the ALC controller willissue an alarm. After manually resetting HPS1 at the unit, the HPS1 alarm will reset. Following a minimum time off delay, compressor #1 will turn on. If the ALC controller records 3 high pressure start/restart failure incidents within 1 hour, compressor #1 is locked out and the ALC controller will issue an alarm. The compressor lock-out can be reset in the Equipment Interface or by cycling the power of the ALC controller.
  - This sequence is the same for compressor #2, Y2, and HPS2.

- Low Pressure Switch (LPS1): If LPS1 is open after the LPS1 by-pass time, the ALC controller will issuean alarm and compressor #1 turns off. After 30 seconds (fixed), the LPS1 alarm will reset. Following aminimum time off delay, compressor #1 will turn on. If the ALC controller records 3 low pressure start/restart failure incidents within 1 hour, compressor #1 is locked out and the ALC controller will issue an alarm. The compressor lock-out can be reset in the Equipment Interface or by cycling the power of the ALC controller.

  - This sequence is the same for compressor #2, Y2, and LPS2.

Safety Shutdown:

- Smoke Detector: When a smoke detector (SD) is provided, it is wired directly to the ALC controller. If smokeis detected, the ALC controller will shut down the unit.
- If the ALC controller detects an SAT sensor failure.

Start-up Settings, Controls, and Options

- Refer to the Addison Quick Start Guide for procedures to modify operating parameters and select options.

Standard Alarms: (alarms require reset in the Equipment Interface or cycling the power of the ALC controller unless noted)

1. OADA Alarm: When the OADA fails to open or closes due to OADA-A (adj.) being open; following 2 minute (adjustable) delay. Unit will automatically shut down.
2. OADA Hand: When the OADA is commanded closed but the OADA-A (adj.) still indicates to the ALC it is open; following 2 minute (adjustable) delay.
3. ECW Alarm: When the ECW fails to start or stops due to WM-CS open; following 1 minute (adjustable) delay.
4. ECW Hand: When the ECW is commanded off but the WM-CS still indicates to the ALC it is on; following 1 minute (adjustable) delay.
5. Supply Fan Alarm: When the SF fails to start and the SF-APS does not confirm air flow to ALC, following 1 minute (adjustable) delay. Unit will automatically shut down.
6. Supply Fan Hand: When the SF is commanded off and the SF-APS still indicates air flow to ALC, following 1 minute (adjustable) delay. OA Damper (if existing) will be commanded to remain open.
7. High Supply Duct Pressure Alarm: When the SF-DPT exceeds 5" H2O (adjustable), following a 5 sec.(fixed) delay. Unit will automatically shut down. Alarm resets when SF-DPT goes below 5" H2O, following a 2 minute (adjustable) delay. Lock out occurs if alarm happens 3 times in 1 hour (High Supply Duct Pressure STOP).
8. Exhaust Fan Alarm: When the EF fails to start and the EF-APS does not confirm air flow to ALC, following 1 minute (adjustable) delay.
9. Exhaust Fan Hand: When the EF is commanded off and the EF-APS still indicates air flow to ALC, following 1 minute (adjustable) delay.
10. Compressor #1 Alarm: Compressor stops due to CC1-CS open; following 60 second (fixed) delay. Compressor lock out occurs if alarm happens 3 times in 1 hour (Compressor #1 STOP).
11. Compressor #1 Hand: Compressor is commanded off but the CC1-CS still indicates to the ALC it is on; following 60 second (fixed) delay.
12. High Pressure Switch #1 Alarm: Compressor stops due to HPS1 open; following 30 second (fixed) delay. Requires HPS1 manual reset at the unit. Compressor lock out occurs if alarm happens 3 times in 1 hour (High Pressure Switch #1 STOP).
13. Low Pressure Switch #1 Alarm: Compressor stops due to LPS1 open; following 90 second (fixed) delay. Compressor lock out occurs if alarm happens 3 times in 1 hours (Low Pressure Switch #1 STOP).
14. Freeze Protection #1 Alarm: Compressor stops due to DX LAT1 freeze condition; following 3 minute (adjustable) delay. Compressor lock out occurs if alarm happens 3 times in 2 hours (FP #1 STOP).
15. Compressor #2 Alarm: Compressor stops due to CC2-CS open; following 60 second (fixed) delay. Compressor lock out occurs if alarm happens 3 times in 1 hour (Compressor #2 STOP).

16. Compressor #2 Hand: Compressor is commanded off but the CC2-CS still indicates to the ALC it is on;following 60 second (fixed) delay.
17. High Pressure Switch #2 Alarm: Compressor stops due to HPS2 open; following 30 second (fixed) delay. Requires HPS2 manual reset at the unit. Compressor lock out occurs if alarm happens 3 times in 1 hour (High Pressure Switch #2 STOP).
18. Low Pressure Switch #2 Alarm: Compressor stops due to LPS2 open; following 90 second (fixed) delay. Compressor lock out occurs if alarm happens 3 times in 1 hours (Low Pressure Switch #2 STOP).
19. Freeze Protection #2 Alarm: Compressor stops due to DX LAT2 freeze condition, following 3 minute (adjustable) delay. Compressor lock out occurs if alarm happens 3 times in 2 hours (FP #2 STOP).
20. Sensor Failure: Readings exceed sensor limits, following 2 minute (fixed) delay. Alarms reset automatically.
21. SAT Sensor Failure: Open: -60.2°F, Short: 296°F. Unit will automatically shut down.
22. High SAT Alarm: SAT high limit, 120°F (adjustable) with Electric Heat. Alarm resets automatically.
23. Low SAT Alarm: SAT low limit, 40°F (adjustable), following 10 minute (adjustable) delay. Unit will automatically shut down.
24. Heat Failure: In heating mode and the SAT falls below 50°F (adjustable), following 10 minute (adjustable) delay. Alarm resets automatically.
25. Condensate Overflow Alarm: If the Condensate Overflow switch opens, following a 30 second (fixed) delay. Unit will automatically shut down.
26. Smoke Detector Alarm: When smoke is detected, following 30 second (fixed) delay. Unit will automatically shut down.

1.7 GAS METER:

The controller shall monitor the gas meter for gas consumption on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Meter Failure: Sensor reading indicates a loss of pulse output from the gas meter.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the gas meter. Peak readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record gas meter readings so as to provide a gas consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**
Gas Flow Rate	x									
Demand									x	
Peak Today									x	
Peak Month-to-Date									x	
Peak Year-to-Date									x	
Usage Today									x	
Usage Month-to-Date									x	
Usage Year-to-Date									x	
Meter Failure										x

1.8 WATER METER:

Water Meter:

The controller shall monitor the water meter for water consumption on a continual basis. These values shall be made available to the system at all times.

Alarm shall be generated as follows:

- Meter Failure: Sensor reading indicates a loss of pulse output from the water meter.

Peak Demand History:

The controller shall monitor and record the peak (high and low) demand readings from the water meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

Usage History:

The controller shall monitor and record water meter readings so as to provide a water consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

	Hardware Points				Software Points					
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**
Water Flow Rate	x									
Demand									x	
Peak Today									x	
Peak Month-to-Date									x	
Peak Year-to-Date									x	
Usage Today									x	
Usage Month-to-Date									x	
Usage Year-to-Date									x	
Meter Failure										x

1.9 SEWAGE LIFT STATION:

The local BMS shall provide monitoring of sewage lift station status and alarm, where applicable. Coordinate with Plumbing/Civil.

2.0 EMERGENCY GENERATOR(S):

The local BMS shall provide monitoring of emergency generator(s) status and alarms via Modbus TCP communication interface provided by Division 26. Coordinate with Specifications 26 3213. The following points shall be monitored:

- Control Switch Not In Auto
- Emergency Stop
- Generator running
- Overcrank
- Engine RPM
- Battery Voltage
- Low Coolant/Water Temperature
- High Coolant/Water Temperature Pre-Alarm
- High Coolant/Water Temperature Shutdown
- Low Oil Pressure Pre-Alarm
- Low Oil Pressure Shutdown
- Overspeed
- Low Fuel Alarm (Diesel only)
- Current, per phase RMS and neutral (if applicable)
- Current Unbalance %
- Voltage, phase-to-phase and phase-to-neutral
- Voltage Unbalance %
- Real power, per phase and 3-phase total
- Apparent power, per phase and 3-phase total

- Reactive power, per phase and 3-phase total
- Power factor, 3-phase total and per phase
- Frequency
- Accumulated Energy (MWH, MVAH, and MVARH)
- Need service

2.1 ELECTRICAL SUB METERING

Integrate electrical main and sub meters for MSA (1 main, 7 sub), MSB (1 main, 10 sub), MSC (1 main, 8 sub), and MSD (1 main, 8 sub) via three Schneider Electric EGX gateways (provided and configured by others) into the BAS via Modbus TCP. All available points shall be included.

APPENDIX A: Glossary of Terms

Terms used within the Specification Text:

- **Advanced Application Controller (AAC):**

  A fully programmable control module. This control module may be capable of some of the advanced features found in Building Controllers (storing trends, initiating read and write requests, etc.) but it does not serve as a master controller. Advanced Application Controllers may reside on either the Ethernet/IP backbone or on a subnet.

- **Application Specific Controller (ASC):**

  A pre-programmed control module which is intended for use in a specific application. ASCs may be configurable, in that the user can choose between various pre-programmed options, but it does not support full custom programming. ASCs are often used on terminal equipment such as VAV boxes or fan coil units. In many vendors' architectures ASCs do not store trends or schedules but instead rely upon a Building Controller to provide those functions.

- **BACnet/IP:**

  An approved BACnet network type which uses an Ethernet carrier and IP addressing.

- **BACnet MS/TP:**

  An approved BACnet network type which uses a Master-Slave Token Passing configuration. MS/TP networks are unique to BACnet and utilize EIA485 twisted pair topology running at 9600 to 76,800 bps.

- **BACnet over ARCNET:**

  An approved BACnet network type which uses an ARCNET (attached resource computer network) carrier. ARCNET is an industry standard that can utilize several speeds and wiring standards. The most common configuration used by BACnet controllers is an EIA485 twisted pair topology running at 156,000 bps.

- **Building Controller (BC):**

A fully programmable control module which is capable of storing trends and schedules, serving as a router to devices on a subnet, and initiating read and write requests to other controllers. Typically this controller is located on the Ethernet/IP backbone of the BAS. In many vendors' architectures a Building Controller will serve as a master controller, storing schedules and trends for controllers on a subnet underneath the Building Controller.

- **Direct Digital Control (DDC):**

  A control system in which a digital computer or microprocessor is directly connected to the valves, dampers, and other actuators which control the system, as opposed to indirectly controlling a system by resetting setpoints on an analog pneumatic or electronic controller.

- **PICS - Protocol Implementation Conformance Statement:**

  A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

- **Smart Actuator (SA):**

  An actuator which is controlled by a network connection rather than a binary or analog signal. (0-10v, 4-20mA, relay, etc.)

- **Smart Sensor (SS):**

  A sensor which provides information to the BAS via network connection rather than a binary or analog signal. (0-10000 ohm, 4-20mA, dry contact, etc.)

- **Web services:**

  Web services are a standard method of exchanging data between computer systems using the XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services can be used at any level within a Building Automation System (BAS), but most commonly they are used to transfer data between BAS using different protocols or between a BAS and a non-BAS system such as a tenant billing system or a utility management system.

Terms used within the Sequences of Operation:

- **adj.**

  Adjustable by the end user, through the supplied user interface.

- **AI, AO, etc. (Column Headings on Points List)**

  AI = Analog Input. A physical input to the control module.

  AO = Analog Output. A physical output from the control module.

  AV = Analog Value. An intermediate (software) point that may be editable or read-only. Editable AVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only AVs are typically used to display the status of a control operation.

  BI = Binary Input. A physical input to the control module.

  BO = Binary Output. A physical output from the control module.

BV = Binary Value. An intermediate (software) point that may be editable or read-only. Editable BVs are typically used to allow the user to set a fixed control parameter, such as a setpoint. Read Only BVs are typically used to display the status of a control operation.

Sched = Schedule. The control algorithm for this equipment shall include a user editable schedule.

Trend. The control system shall be configured to collect and display a trend log of this object. The trending interval shall be no less than one sample every 5 minutes. (Change of Value trending, where a sample is taken every time the value changes by more than a user-defined minimum, is an acceptable alternative.)

Alarm. The control system shall be configured to generate an alarm when this object exceeds user definable limits, as described in the Sequence of Controls.

Note: If the specifications require use of the BACnet protocol, all of the above shall be provided as BACnet objects.

- **KW Demand Limiting:** (*Energy saving option that may not be a standard feature for all vendors, and which may be implemented differently by those vendors who support it.)

  An energy management strategy that reduces energy consumption when a system's electric power meter exceeds an operator-defined threshold.

  When power consumption exceeds defined levels, the system automatically adjust setpoints, de-energizes low priority equipment, and takes other pre-programmed actions to avoid peak demand charges. As the demand drops, the system restores loads in a predetermined manner.

- **Occupant Override Switch, or Timed Local Override:**

  A control option that allows building occupants to override the programmed HVAC schedule for a limited period of time.

  When the override time expires, the zone returns to its unoccupied state.

- **Occupant Setpoint Adjustment:**

  A control option that allows building occupants to adjust - within limits set by the HVAC control system - the heating and cooling setpoints of selected zones. Typically the user interface for this function is built into the zone sensor.

- **Optimal Start-Up:** (*Energy saving option that may not be a standard feature for all vendors, and which may be implemented differently by those vendors who support it.

  A control strategy that automatically starts an HVAC system at the latest possible time yet ensures comfort conditions by the time the building becomes occupied.

  In a typical implementation, a controller measures the temperature of the zone and the outside air. Then, using design heating or cooling capacity at the design outside air temperature, the system computes how long a unit must run at maximum capacity to bring the zone temperature to its occupied setpoint.

The optimal start algorithm often includes a self-learning feature to adjust for variations from design capacity.

A distributed system must use Run on Request with Optimal Start. (See below.)

- **Requested, or Run on Request:** (*Energy saving option that may not be a standard feature for all vendors, and which may be implemented differently by those vendors who support it.

  A control strategy that optimizes the runtime of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service. Source equipment runs only when needed, not on a fixed schedule.

  The source equipment runs when one or more receiving units request its services. An operator determines how many requests are required to start the source equipment.

  For example, if all the zones in a building are unoccupied and the zone terminal units do not need heating or cooling, the AHU will shut down. However, if a zone becomes occupied or needs cooling, the terminal unit will send a run request to the AHU to initiate the start-up sequence. If this AHU depends on a central chiller, it can send a run request to the chiller.

  The run on request algorithm also allows an operator to schedule occupancy for individual zones based on the needs of the occupants without having to adjust the schedules of related AHUs and chillers.

- **Trim and Respond, or Setpoint Optimization:** (*Energy saving option that may not be a standard feature for all vendors, and which may be implemented differently by those vendors who support it.

  A control strategy that optimizes the setpoint of a source piece of equipment that supplies one or more receiving units - such as an air handler unit supplying zone terminal units with heating, cooling, ventilation, or similar service.

  The source unit communicates with receiving units to determine heating, cooling, and other requirements, and then adjusts its setpoint.

  For example, if all zones are comfortable and do not request cooling, the AHU will gradually increase (trim) its supply air setpoint. When a zone requests cooling, the AHU responds by dropping its setpoint. The more zones that request cooling, the more it drops the setpoint. The AHU repeats this process throughout the day to keep zones cool, but with a supply air setpoint that is no cooler than necessary.

Contracting Terms:

- **Furnished or Provided:**

  The act of supplying a device or piece of equipment as required meeting the scope of work specified and making that device or equipment operational. All costs required to furnish the specified device or equipment and make it operational are borne by the division specified to be responsible for providing the device or equipment.

- **Install or Installed:**

The physical act of mounting, piping or wiring a device or piece of equipment in accordance with the manufacturer's instructions and the scope of work as specified. All costs required to complete the installation are borne by the division specified to include labor and any ancillary materials.

- **Interface:**

  The physical device required to provide integration capabilities from an equipment vendor's product to the control system. The equipment vendor most normally furnishes the interface device. An example of an interface is the chilled water temperature reset interface card provided by the chiller manufacturer in order to allow the control system to integrate the chilled water temperature reset function into the control system.

- **Integrate:**

  The physical connections from a control system to all specified equipment through an interface as required to allow the specified control and monitoring functions of the equipment to be performed via the control system.

APPENDIX B: Abbreviations

The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

AC - Air Conditioning
ACU - Air Conditioning Unit
AHU - Air Handling Unit
AI - Analog Input
AO - Analog Output
AUTO - Automatic
AUX - Auxiliary
BI - Binary Input
BO - Binary Output
C - Common
CHW - Chilled Water
CHWP - Chilled Water Pump
CHWR - Chilled Water Return
CHWS - Chilled Water Supply
COND - Condenser
CW - Condenser Water
CWP - Condenser Water Pump
CWR - Condenser Water Return
CWS - Condenser Water Supply
DA - Discharge Air
EA - Exhaust Air
EF - Exhaust Fan
EVAP - Evaporators
FCU - Fan Coil Unit
HOA - Hand / Off / Auto
HP - Heat Pump
HRU - Heat Recovery Unit
HTEX - Heat Exchanger
HW - Hot Water

HWP - Hot Water Pump
HWR - Hot Water Return
HWS - Hot Water Supply
MAX - Maximum
MIN - Minimum
MISC - Miscellaneous
NC - Normally Closed
NO - Normally Open
OA - Outdoor Air
PIU - Powered Induction Unit
RA - Return Air
RF - Return Fan
RH - Relative Humidity
RTU - Roof-top Unit
SA - Supply Air
SF - Supply Fan
SP - Static Pressure
TEMP - Temperature
UH - Unit Heater
UV - Unit Ventilator
VAV - Variable Air Volume
VVTU - Variable Volume Terminal Unit
W/ - with
W/O - without
WSHP - Water Source Heat Pump

END OF SECTION

SECTION 23 2113
PIPING AND ACCESSORIES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. It should be noted that all products, piping, valves, fittings, and accessories specified in this section are for systems with maximum operating pressures of 150 psig in order to establish the type and quality of products required. Where the maximum operating pressure is greater than 150 psig in any system, furnish and install products, piping, valves, fittings, and accessories with pressure classifications that are suitable for the operating pressures. In general, all valves, fittings, and accessories below 350 feet of the highest piping point must have pressure ratings of 300 psig or greater. Above 351 feet and below 575 feet of the highest piping point pressure ratings shall be 500 psig or greater.

C. Piping and accessories installed indoors shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install all piping and accessories, complete, as indicated and specified herein.

B. Without limiting the generality thereof, the work in this section shall include the following items:
1. Piping
2. Hangers and Supports
3. Suction diffusers
4. Flexible connections
5. Thermometers
6. Pressure gauges
7. Combination pressure/temperature test ports
8. Heat cable for freeze protection of piping
9. Piping Identification
10. Painting of pipe
11. Expansion Compensation

C. Makeup water connections from the connection left under the Plumbing Section to the systems shall be the same as specified under Plumbing for Cold Water.

D. Piping shall be manufactured in the United States. Submit Certificate of Manufacture with shop drawings.

E. Submit a copy of the water quality analysis to illustrate the water quality at the project site.

1.03 RELATED WORK

A. Section 23 05 23 – VALVES FOR HVAC PIPING

B. Section 23 21 16 - HYDRONIC PIPING SPECIALTIES

1.04 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of reinforced thermosetting resin (fiberglass) fittings (RTRF) and reinforced thermosetting resin (fiberglass) pipe (RTRP) shall be certified by the manufacturer of pipe and fittings as having been trained and qualified to join fiberglass piping with manufacturer recommended adhesive.
3. Polypropylene Pipe and Fitting Installers: Installers of polypropylene piping shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join polypropylene piping using fusion welding of the same type as specified in Drawings (socket, butt, eletrofusion, fusion outlet).

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, “Structural Welding Code – Steel”.

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
1. Comply with provisions in ASME B31 Series, “Code for Pressure Piping”.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, “Building Services Piping” for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

PART 2 - PRODUCTS

2.01 PIPING

A. Refer to table below for pipe and fittings materials.

Branch piping connections may be made using welding nozzles such as Weldolets or Thredolets and manufactured by Bonney Forge & Tool Works or equal. All welding shall be in accordance with the Standard Manual of Pipe Welding Contractors National Association.

Bolted branch outlets, Mechanical-T™, as manufactured by Victaulic or engineer approved equal may be used in lieu of Weldolets and Thredolets in applicable sizes. Mechanical-T shall feature a locating collar that aligns and secures the outlet housing in the proper location. U-bolt straps are not acceptable.

B. Grooved joint couplings shall consist of two or more housings manufactured of ductile iron conforming to ASTM A536, zinc electroplated carbon steel bolts and nuts, and pressure responsive elastomer gasket. (Gasket grade shall be suitable for the intended service. Gasket shall be manufactured by the coupling manufacturer.)
1. Rigid Type: Couplings to be installation ready or advanced grooved system design, to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style 107, W07, 607, 905 or Apollo Shurjoint Z07, Z07N, or engineer approved equal.

2. Flexible Type: Couplings to be installation ready or advance grooved system design. Flexible couplings may be used in lieu of flexible connectors at equipment connections and per manufacturer's guidelines on expansion loops or seismic joints. Victaulic Style 177, W77, Apollo Shurjoint 7707, 7707N, C305 or engineer approved equal.
3. Flange Adapters: Flat Face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741, Apollo Shurjoint 7041 or engineer approved equal.

C. Final connections to equipment shall be made with unions, grooved joint couplings, or flanges.

D. Gaskets for flanged joints shall be 1/16" thick, suitable for the service.

E. Drain piping:
1. Condensate drains from cooling coils shall be trapped as detailed and routed to the nearest plumbing drain as indicated.
2. Drain piping from air intake plenums and drip pans shall be routed to the nearest plumbing drain and shall terminate with an elbow turned down into the drain.
3. Pump drip pan drains shall be Type "M" copper with wrought fittings.
4. Where indicated, Schedule 40 DWV PVC pipe, ASTM D1785, is acceptable. Install per ASTM D2321. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM D2665. Joints: Solvent joints for PVC, ASTM D2564. (PVC piping is not acceptable for waste piping receiving discharge higher than 130 °F.). Foam core PVC piping is not acceptable.
5. CPVC piping is not allowed for condensate drain piping from direct expansion equipment.

F. Chilled water and hot water supply and return piping systems in sizes up to 2" may be copper or stainless steel, using the Apollo"Press", Victaulic Vic-Press 304™, or the Viega ProPress piping system of couplings, fittings, and valves, in lieu of threaded steel and soldered copper.

G. The city water piping to all HVAC equipment shall be Type "L" hard tempered copper with wrought copper fittings. It shall be installed as detailed on the plans and in compliance with the equipment manufacturer's recommendations. The water supply will be left by the plumbing subcontractor, extended and connected to the equipment by the HVAC subcontractor. This piping will be insulated to match that which the plumbing subcontractor supplies.

H. High points of each water main shall be fitted with an automatic or manual air vent. Low points of water systems shall be fitted with a ¾" drain valve with hose end connection.

I. Copper Pressure-Seal-Joint Fittings:

a) Basis-of-Design Product: Subject to compliance with requirements, provide Apollo Press Fittings, made in the USA, or comparable product by one of the following:
(1) Viega ProPress
b) For Types K, L, and M hard copper tubing NPS ½ (DN 15) to NPS 4 (DN 100) and soft copper tubing in NPS ½ (DN 15) to NPS 1¼ (DN 32).
c) Housing: Copper or bronze.
d) Sealing Element: EPDM.
e) Multiple leak path detection system.

f) IAPMO PS-117.
g) Tools: Manufacturer's special tools.
h) Maximum 200 psig (1379 kPa) working-pressure.
i) Maximum temperature rating at 250°F (121°C).
j) Maximum test pressures at 600 psig (4136 kPa).

k) Fittings for NPS 2 (DN 50) and smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

l) Fittings for NPS 2½ to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper with stainless-steel grip ring and EPDM-rubber, O-ring seal in each end.

J. Pipe and Fitting Materials:

PIPE AND FITTINGS SCHEDULE

SERVICE	SIZE	PIPE MATERIAL	FITTINGS	JOINTS	UNIONS	FLANGES	NOTES
CHILLED WATER HOT WATER	3/4" TO 2"	TYPE "L" COPPER ASTM B88	WROUGHT COPPER ASME B16.22	LEAD FREE SOLDER	COPPER TO COPPER GROUND JOINT ASME B16.22	N/A	
CHILLED WATER HOT WATER CONDENSER WATER	3/4" TO 2"	STD WEIGHT SCH 40 STEEL ASTM A53, GRADE B, TYPE E	CLASS 150 MALLEABLE IRON ASME B16.3	THREADED	CLASS 150 MALLEABLE IRON GROUND JOINT WITH BRONZE TO IRON SEAT - ASME B16.39	N/A	
CHILLED WATER HOT WATER CONDENSER WATER	2 1/2" TO 10"	STD WEIGHT SCH 40 STEEL ASTM A53, GRADE B, TYPE E	STD. WEIGHT BUTT WELD: WROUGHT STEEL ASME B16.9; GROOVED: DUCTILE IRON ASTM A536	BUTT WELDED OR GROOVED	N/A	CLASS 150 WROUGHT STEEL RAISED FACE SLIP-ON W/ FULL FACE GASKET ASME B16.9 ASTM A234 WPB	
CHILLED WATER HOT WATER CONDENSER WATER	12" AND LARGER	STD WT STEEL ASTM A53, GRADE B, TYPE E	STD. WEIGHT BUTT WELD: WROUGHT STEEL ASME B16.9; GROOVED: DUCTILE IRON ASTM A536	BUTT WELDED OR GROOVED	N/A	CLASS 150 WROUGHT STEEL RAISED FACE SLIP-ON W/ FULL FACE GASKET ASME B16.9 ASTM A234 WPB	

TEMPERED WATER	3/4" TO 2"	STD WEIGHT SCH 40 STEEL ASTM A53, GRADE B, TYPE E	CLASS 150 MALLEABLE IRON ASME B16.3	THREADED	CLASS 150 MALLEABLE IRON GROUND JOINT WITH BRONZE TO IRON SEAT - ASME B16.39	N/A	
TEMPERED WATER	2 1/2" TO 10"	STD WEIGHT SCH 40 STEEL ASTM A53, GRADE B, TYPE E	STD. WEIGHT BUTT WELD: WROUGHT STEEL ASME B16.9 GROOVED: DUCTILE IRON ASTM A536	BUTT WELDED OR GROOVED	N/A	CLASS 150 WROUGHT STEEL RAISED FACE SLIP-ON W/ FULL FACE GASKET ASME B16.9 ASTM A234 WPB	
TEMPERED WATER	12" AND LARGER	STD WT STEEL ASTM A53, GRADE B, TYPE E	STD. WEIGHT BUTT WELD: WROUGHT STEEL ASME B16.9 GROOVED: DUCTILE IRON ASTM A536	BUTT WELDED OR GROOVED	N/A	CLASS 150 WROUGHT STEEL RAISED FACE SLIP-ON W/ FULL FACE GASKET ASME B16.9 ASTM A234 WPB	
CHILLED WATER HOT WATER CONDENSER WATER TEMPERED WATER	3/4" TO 4"	POLYPROPYLENE (PP-R) ASTM F2389-17a (SEE NOTE 5)	SOCKET FUSION	SOCKET FUSION	1/2" TO 2" BY PIPE MANUFACTURER, >2" N/A	SOCKET FUSION WITH FLANGE ADAPTER AND FULL-FACE RUBBER GASKET	SEE NOTE 5
CHILLED WATER HOT WATER CONDENSER WATER TEMPERED WATER	6" TO 24"	POLYPROPYLENE (PP-R) ASTM F2389-17a (SEE NOTE 5)	BUTT FUSION	BUTT FUSION	N/A	BUTT FUSION WITH FLANGE ADAPTER AND FULL-FACE RUBBER GASKET	SEE NOTE 5
CHILLED WATER HOT WATER TEMPERED WATER	3/4" TO 2"	CROSSLINKED POLYETHENE (PEX) ASTM F876 AND F877 (SEE NOTE 5)	COPPER CRIMP ASTM F1807, SS CLAMP ASTM F2098, COLD EXPANSION RINGS ASTM F1960	COPPER CRIMP ASTM F1807, SS CLAMP ASTM F2098, COLD EXPANSION RINGS ASTM F1960	N/A	N/A	SEE NOTE 5

CHILLED WATER HOT WATER TEMPERED WATER	1/2" TO 2"	SCH. 40 ZINC-NICKEL COATED STEEL, ASTM A106 GRADE A	STD. WT. ZINC-NICKEL COATED STEEL WITH EPDM O-RING	MECH. PRESS FIT	STD. WT. ZINC-NICKEL COATED STEEL WITH EPDM O-RING	N/A	
CONDENSER WATER BELOW GRADE	4" TO 12"	SCH. 40 PVC 12454 ASTM D1784	SCH. 40 PVC ASTM D2466	SOLVENT WELD ASTM D2564	N/A	N/A	SEE NOTE 6
CONDENSATE DRAIN	3/4" TO 3"	TYPE "M" COPPER ASTM B88 OR DWV ASTM B306	WROUGHT COPPER ASTM B16.29	SOLDER 50/50	COPPER TO COPPER GROUND JOINT	N/A	
CONDENSATE DRAIN	3/4" TO 3"	SCH. 40 PVC 12454 ASTM D1784 OR DWV ASTM D2665	SCH. 40 PVC ASTM D2466	SOLVENT WELD ASTM D2564	SCH. 40 PVC	N/A	SEE NOTE 7
COMPRESSED AIR	1/2" TO 4"	COPPER TYPE "L" ASTM B88	WROUGHT COPPER ASME B16.22	SOLDER 50/50	CAST BRONZE TO COPPER ASME B16.18	CLASS 150 CAST BRONZE ASME B16.18	
COMPRESSED AIR	1/2" TO 4"	COPPER TYPE "L" ASTM B88	WROUGHT COPPER WITH EPDM O-RING	MECH. PRESS FIT	LEAD FREE BRASS	CLASS 150 WROUGHT COPPER	
COMPRESSED AIR	1/2" TO 2"	SCH. 40 ZINC-NICKEL COATED STEEL, ASTM A106 GRADE A	STD. WT. ZINC-NICKEL COATED STEEL WITH EPDM O-RING	MECH. PRESS FIT	STD. WT. ZINC-NICKEL COATED STEEL WITH EPDM O-RING	N/A	

NOTES:
1. REFER TO PIPING AND INSULATION SPECIFICATIONS FOR ADDITIONAL INFORMATION.
2. FOR HANGER AND SUPPORT SPACING, REFER TO PIPE HANGER SPACING TABLE.
3. PIPE, FITTINGS AND ACCESSORIES INSTALLED INDOORS SHALL HAVE A FLAME-SPREAD INDEX OF 25 OR LESS, AND A SMOKE-DEVELOPED INDEX OF 50 OR LESS.
4. FOR INSULATED PIPE, SIZE HANGERS TO INCLUDE INSULATION THICKNESS. PROVIDE COMPLETE SYSTEM (WITH INSTALLATION DETAILS) IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL COMMERCIAL AND INDUSTRIAL INSULATION STANDARDS MANUAL MICA PLATES OR MANUFACTURER'S RECOMMENDATIONS.
5. METALLIC PIPE SUPPORTS MUST BE INSTALLED PER THE MANUFACTURER'S LISTING IN ORDER TO ACHIEVE SMOKE DEVELOPED INDEX OF 50 OR LESS WHEN TESTED PER ASTM E84.
6. INSTALL PER ASTM D2774 – STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PRESSURE PIPE.
7. FOAM CORE PVC IS NOT ACCEPTABLE.

2.02 PIPE SUPPORTS

A. All pipe supports, clamps, and inserts shall be provided under this section. Pipe hanger assemblies shall include turnbuckles or other means of vertical adjustment. Trapeze hangers may be used in lieu of separate hangers for closely spaced, parallel lines. Pipe

hangers shall be as manufactured by Carpenter & Patterson, Inc., B-Line, Anvil Int'l, PHD Manufacturing, Inc. or approved equal. Product numbers used below are Carpenter and Patterson.

B. All piping above grade shall be supported by the building structure and shall not rest on ceiling tiles or the ceiling structure. Piping hung from joists shall be hung from the top chord of the joists.

C. Vertical runs shall be supported at the roof, each floor and at 10' intervals between floors.

D. Hangers for steel piping 2" and smaller shall be Figure 100 band type. Hangers for piping 2½" to 5" shall be Figure 100. Hangers for piping 6" and larger shall be Figure 100. Hangers shall have steel rods with two (2) nuts and shall be suspended from suitable beam clamps or concrete inserts.

E. Hanger spacing and rod sizes for single point support shall be per the table below:

HORIZONTAL PIPE SUPPORT SPACING*

Pipe Size	Maximum Horizontal Hanger Spacing in Feet (1)(2)				Minimum Rod Size (inches)
	Steel		Copper	PVC Sch 40	
	Water	Steam	Water	Condensate	
½	12	12	12	4	1/4
¾	12	12	12	4	1/4
1	12	12	12	4	1/4
1¼	12	12	12	4	3/8
1½	12	12	12	4	3/8
2	12	12	12	4	3/8
2½	12	12	12	4	3/8
3	12	12	12	4	3/8
4	12	12	12	-	1/2
5	12	12	12	-	1/2
6	12	12	12	-	1/2
8	12	12	12	-	5/8
10	12	12	12	-	3/4
12	12	12	12	-	7/8
14	12	12	12	-	1
16	12	12	12	-	1
18	12	12	12	-	1¼
20	12	12	12	-	1¼
22	12	12	12	-	-
24	12	12	12	-	-

*Spacing intervals comply with 2015 IMC/IPC
(1) Spacing does not apply where span calculations are made or where concentrated loads are placed between supports such as flanges, valves, specialties, etc.

(2) IMC/IPC permits alternate support spacing per ANSI/MSS SP-58. For alternate support spacing refer to Horizontal Pipe Support Spacing - ANSI schedule.

F. Rod for trapeze hangers supporting several pipes shall be sized for the equipment load per manufacturer's recommendations.

G. Hangers for copper piping shall be similar to above for steel piping but where in contact with the copper piping, they shall be copper plated.

H. Hangers for insulated lines shall have insulation saddles and shields.

I. Pipe Vibration Hangers:
   1. All piping attached to the building serving air handlers, air conditioners, pumps, chillers, etc., with rotating or pulsating parts shall be hung on spring type isolation hangers for at least 20 feet horizontally from where it attaches to any of the above. The spring hangers shall be capable of 1" deflection and when actually loaded, have at least ½" deflection.

J. Roof mounted pipe supports:
   1. Condensate drain and refrigerant piping routed on the roof shall be supported with UV resistant rubber support system; Mifab C Series or equal by Dura-Blok.
   2. Roof mounted piping shall be supported at 6' intervals with pipe stands, framing systems, roller stands, curbs, etc. Support shall be provided at each change of direction and at branch take-offs. Submit layout drawings and product information during the submittal phase.

2.03 SLEEVES AND PLATES

A. All pipes passing through masonry walls shall be fitted with schedule 40 steel pipe sleeves. Sleeves shall be of the first possible size larger than the outside diameter of the pipe to be sleeved or the insulation jacket on covered pipes. Sleeves shall be flush on either side of the masonry walls.

B. All pipes passing through the masonry floors shall be fitted with schedule 40 steel pipe sleeves of the first size larger than the pipe to be sleeved. All sleeves on these floors shall extend 1" above the finished floor and 1" below the bottom of the slab. All pipe sleeves through the floors of the mechanical room shall be 16-gauge galvanized steel extending 2" above the finished floor. After the pipes are installed, the annular space shall be packed with fiberglass to ½" from the top of the sleeves, and then topped off with a ½" depth of sealant such as PRC-Rubber Caulk 7000 or other such approved sealant.

C. All exposed, uncovered pipes passing through walls or ceilings shall be fitted with chromium plated spun or split type escutcheons with a clamping device for holding the escutcheon in position.

D. All exposed uncovered pipes passing through floors shall be fitted with chromium plated spun or split type escutcheons which shall be high enough to cover the pipe sleeve and shall be fitted with a clamping device for holding the escutcheon in position and which shall rest upon the finished floor.

E. Piping entering the building below grade and passing through cast-in-place concrete walls or floors shall be fitted with a mechanical rubber seal inside of a 12" long schedule 40 steel pipe sleeve with integral water-stop. The sleeve shall be sized to house the mechanical rubber seal and carrier pipe. The mechanical rubber seal shall be constructed of EPDM

and stainless-steel hardware and provide a hydrostatic seal of up to 20 psi and up to 40 feet of head. Products shall be Metraseal as manufactured by The Metraflex Company or equal by Link-Seal.

2.04 SUCTION DIFFUSERS

A. Suction diffusers shall consist of an angle type body with screwed, flanged or grooved connections sized to mate with the pump suction connection.

B. The suction diffuser shall have an integrated flow cone, carbon steel (stainless steel for open piping systems) straightening vane and a combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection. The unit shall include a disposable 16 mesh bronze strainer which shall be removed after system start-up.

C. Unit shall be equipped with factory installed pressure/temperature test ports on the suction and discharge connections to allow for measurement of differential pressure across the suction diffuser. Manufacturer's literature shall include a performance chart with the total pressure drop across the unit for each size installed.

D. Unit shall be fitted with a blowdown connection on the bottom of the casing to facilitate cleaning without removing the cylinder orifice.

E. Orifice cylinder shall be designed to withstand pressure differential equal to pump shut-off head and shall have a free area equal to five times the cross-sectional area of the pump suction opening. Vane length shall be no less than 2½ times the pump connection diameter.

F. Suction diffusers shall be equipped with an adjustable support foot to carry the weight of the suction piping.

G. Suction diffusers shall be rated as follows:
   1. Threaded and flanged: 175 psi (1,207kPa) maximum working pressure and 250°F (121°C) maximum working temperature.
   2. Grooved: 300 psi (2,068 kPa) maximum working pressure and 250°F (121°C) maximum working temperature.

H. Provide an extra set of O-rings for start-up and strainer removal.

I. Approved manufacturers: Bell & Gossett, Armstrong, Taco, Grundfos, or equal that meets or exceeds these specifications.

2.05 PRESSURE GAUGES

A. Pressure gauges shall be furnished and installed at the suction and discharge connections of each pump, at each coil, or piece or equipment in the system exclusive of accessories.

B. Gauges shall be 4½" diameter with metal case, bronze movement, bronze bourdon tube and brass ring. Gauges shall be accurate within 1% over the entire scale. All gauges shall have "T" handle cocks.

C. Gauges shall have a dial range that will provide a reading at maximum design operating pressure of between 50% and 75% of the dial range. Systems that will go into a vacuum shall also read 0" to 30" of vacuum.

D. Gauges shall be so placed as to be easily readable from the floor.

E. Gauges shall be manufactured by Weiss, Winters, Trerice or approved equal.

2.06 THERMOMETERS

A. Thermometers shall be furnished and installed at each coil or piece or equipment in the system exclusive of accessories unless shown otherwise

B. Thermometers shall be adjustable angle front reading red mercury type with 12" scale. Case shall be cast aluminum.

C. Angle adjustment shall utilize two positive locking set screws.

D. Furnish thermometers of temperature range suited for systems in which they are installed.

E. Thermometer wells shall be the full immersion type matched to thermometer stem length.

F. Furnish thermometers and accessories as manufactured by Weiss, Winters, Trerice or approved equal, at each piece of equipment that has a temperature change in a fluid.

2.07 COMBINATION PRESSURE/TEMPERATURE TEST PORTS (P/T PORTS)

A. Where indicated (unless integral with valves or specialties), provide combination pressure/temperature ports (Pete's Plug II or equal by Caleffi).

B. Test port shall have a ¼" fitting to accept either a temperature or pressure probe with a 1/8" OD fitting. Ports shall be solid brass with two valve cores of Neoprene rated for 500 psi at a maximum of 200°F and fitted with a gasketed color coded cap and strap.

C. At project close-out, present a complete portable test kit to the owner's representative. The kit shall consist of one pressure gauge (0-100 psi [700kPa] range) with a number 500 (1/8"x1½") probe pressure gauge adapter attached, one thermometer (25-125°F range), one thermometer (0-220°F range), an additional number 500-gauge adapter, and a protective carrying case with foam inserts.

2.08 FLEXIBLE CONNECTIONS

A. Furnish and install flexible connections in the piping at all equipment subject to movement or vibration.

B. Fittings materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Copper fittings shall not be attached to stainless steel hose.

C. Types:
   1. Flexible metal hose connectors
      a. Flexible hose connectors shall be manufactured complete with an inner section of Type 304 stainless steel corrugated metal hose and an outer Type 304 stainless steel braid with inlet and outlet connections (threaded up to 2½" pipe size and flanged 3" and larger pipe size).
      b. Flexible hose connectors shall accommodate thermal expansion, contraction or seismic movement of the piping system and shall be capable of compensating for lateral movement and vibration.
      c. Minimum working pressure shall be 220 psi at 70°F
   2. Connectors shall be Model SST (threaded) or Model SLT (flanged) as manufactured by The Metraflex Company or equal by Flex-Hose Company, Inc.
   3. Spherical rubber connectors

a. Rubber connectors/expansion joints shall be of the molded twin spherical type constructed of EPDM with an internal steel anchor wire molded within the raised face ends for added strength. An external steel root ring shall be located between the spheres for additional reinforcement.
b. Spherical rubber connectors shall accommodate thermal expansion, contraction or lateral movement of the piping system and attenuate impeller generated noise transmitted through the pipe wall.
c. Spherical rubber connectors shall be pressure rated for 150 psi at 200°F (2" thru 12" sizes) and 95 psi at 200°F (14" thru 20" sizes) with a minimum 4 to 1 safety factor.
d. Flanges shall be one-piece, free-floating, class 150 galvanized plate steel type with tapped or drilled holes as required.

4. Connectors shall be “Doublesphere” as manufactured by The Metraflex Company or equal by Flex-Hose Company, Inc.
5. Spherical rubber connectors with control rods:
   a. Control Units must be provided in unanchored applications where additional safety factors are required to limit excessive movement or as recommended by the manufacturer.
   b. Control Units shall be as described above for Spherical rubber connectors, but with the following additional features:
      1) Integral cable restraints permanently affixed to the flanges to prevent over-extension.
      2) Control cables shall be of the galvanized aircraft type, and be an integral part of the joint requiring no field adjustment.
   c. Control units shall be “Double Cablesphere” as manufactured by The Metraflex Company or equal by Flex-Hose Company, Inc.

D. At a minimum, flexible connections shall be provided at connections to cooling towers, chillers and base mounted pumps.

E. At the Contractor’s option, the use of a minimum of three (3) flexible type grooved couplings may be substituted for flexible connections. Couplings shall be placed in close proximity to the source of the vibration. Consult coupling manufacturer for proper installation requirements.

F. Where piping crosses building expansion joints, provide spherical rubber connectors as specified above.

2.09 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

A. Provide electric heat tracing on all exterior make-up and condenser water piping above grade.

B. The cable shall consist of 16 AWG nickel plated bus wires, tinned copper braid and modified polyolefin jacket.

C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.

D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.

E. The electric cable shall be the self-regulating type which responds to varying localized temperature conditions by varying the heat output along its length. This shall be

accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.

F. Provide a thermostat control which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). While energized, the heat cable shall be entirely self-regulating.

G. Provide all power connection hardware, splices, end seals, etc. to accomplish a complete installation. All hardware shall be by the same manufacturer as the cable.

H. Electric heating cable and accessories shall be UL Listed-718K Pipe Heating Cable and shall conform to all requirements of Division 26.

I. Voltage shall be as indicated on the electrical drawings. Power circuits shall include ground fault protection.

J. Electric heating cable shall be Raychem XL-Trace or approved equal.

K. For PP-R Piping: Heat Tracing or Freeze Protection: Installed on the pipe interior or exterior; suitable for use with plastic piping; and be self-regulating to ensure surface temperature of the pipe and fittings will not exceed 158°F (70°C).

2.10 PIPING IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following piping installed under this section of the Specifications:
1. Condenser water
2. Chilled water
3. Hot water
4. Auxiliary condenser water
5. Tempered water (heat pump loop)
6. Steam (with pressure rating)
7. Condensate Return (with pressure rating)

B. Piping shall be labeled at each wall penetration (both sides), risers, equipment and each change of direction.
1. For general facility piping, straight runs of piping shall be labeled at intervals not greater than 50 feet and congested areas not greater than 20 feet.
2. For healthcare facilities, straight runs of piping shall be labeled at intervals not greater than 20 feet.

C. The letter size and background color shall conform to ANSI/ASME A13.1 Standard for the Identification of Piping Systems.

D. The labeling system shall consist of UV resistant vinyl tapes and labels suitable for indoor/outdoor use be as manufactured by Seton, Brady, or DuraLabel by Graphic Products.

2.11 EXPANSION COMPENSATION

A. Expansion in piping systems shall be compensated for by the use of u-bends, z-bends, spring isolators, expansion joints or flexible hose connectors as indicated. U-bends, z-bends and flexible hose connectors shall be complete with pipe guides and anchors.

B. Grooved piping systems may be used for expansion loops per manufacturer's guidelines.

C. Expansion joints shall be either bellows type or slip type suitable for the application in which installed.
   1. Bellows type expansion joints shall be manufactured by Metraflex, Mercer Rubber Co., Flexicraft or approved equal.
   2. Slip type expansion joints shall be manufactured by Hi-Span, Yarway, Advanced Thermal Systems or approved equal.

D. All vertical risers subjected to thermal expansion and/or contraction shall incorporate one of the following designs:
   1. Spring type isolators and central anchor system designed to insure loading within design limits at structural support points.
      a. The riser design must be prepared and submitted for approval by the same isolation vendor supplying the HVAC mechanical equipment vibration isolation equipment.
      b. The submittal must include the initial load, initial deflection, change in deflection, final load and change in load at all spring support locations.
      c. In order to minimize load changes, the initial spring deflection must be at least four (4) times the thermal movement. The submittal must also include anchor loads when installed, cold filled, and at operating temperature. Include calculated pipe stress at end conditions and branch take-off locations.
      d. The submittal shall include complete layout drawings, product information and installation instructions.
      e. The submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration equipment vendor for a minimum of five (5) years.
      f. Proper provisions shall be made for seismic protection in applicable seismic zones.
      g. The isolation vendor shall provide and design all brackets at riser spring and anchor locations where standard clamps lack the capacity or do not fit in the space allowed.
      h. Install and adjust all isolators under the supervision of the designing isolation equipment vendor or his authorized representative.
      i. The support spring mounts shall be Type SLF, the anchors Type ADA, and telescoping guides Type VSG, all as manufactured by Mason Industries, Inc.
   2. Flexible hose expansion loop system manufactured complete with two parallel sections of corrugated metal hose, compatible braid, 180 degree return bend, and inlet and outlet connections. Field fabricated loops are not acceptable.
      a. Flexible loops shall be capable of movement in the ±X, ±Y, and ±Z planes.
      b. Flexible hose expansion loops shall impart no thrust loads to system support, anchors or building structure.
      c. Flexible hose expansion loops shall be manufactured in accordance with the documented manufacturer's weld procedure specifications. The procedure qualification record shall be used to document the execution of this procedure and shall follow the general "guidelines" of ASME Section IX.
      d. The manufacturer shall submit dimensioned layout drawings showing anchor loads (cold filled and operating temperatures), anchor and guide locations, support points and fastening methods.
      e. The submittal shall include installation instructions.
      f. Proper provisions shall be made for seismic protection in applicable seismic zones.

g. The submittal must be stamped and signed by a licensed professional engineer in the employ of the manufacturer for a minimum of five (5) years.

h. Corrugated hose and braid shall be constructed of Type 304 stainless steel. Fitting materials of construction and connection fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.

i. Flexible hose expansion loops shall have a factory supplied, hanger/ support lug located at the bottom of the 180 degree return section.

j. Flexible hose expansion loop(s) shall be furnished with a 3/8" plugged FPT to be used for a drain or air release vent.

k. Flexible hose expansion loops shall be Metraloop as manufactured by The Metraflex Company or equal by Flex-Hose Company, Inc.

E. All vertical PVC condensate piping risers in buildings shall have expansion fittings to allow for building shrinkage compensation. The fitting shall be equal to Fernco Expansion Joint Model XJ. Expansion fitting shall be documented specifically for shrinkage of building materials and thermal expansion/contraction.

1. Wood framed buildings shall have a fitting in the first-floor ceiling space and every other floor thereafter.
2. Concrete buildings shall have a fitting in the first-floor ceiling space and every 8 floors thereafter.
3. All buildings stacks shall utilize riser pipe clamps at each floor.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and the instructions of the Engineer. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. Install in the piping all automatic control valves, thermometer wells, and like apparatus furnished by the temperature control manufacturer.

C. Hangers shall be arranged to maintain the required grading and pitch of piping, to prevent vibration and to provide for expansion and contraction.

D. Each vertical line shall be supported at its base using a suitable hanger placed in the horizontal line near the riser, unless otherwise noted, for base elbow support.

E. Grooved Piping Systems:

1. Grooved joints shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Use grooved fittings, couplings, valves, and specialties of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
2. Grooved joint installer training: Contractor shall ensure each coupling installer has been trained on-site by a direct employee of the grooved manufacturer in the use of grooving tools, application of groove, and product installation. Contractor shall submit to the engineer documentation signed and dated by grooved manufacturer, showing the names of the installers that have completed jobsite training.
3. Grooved joint manufacturer inspections: A manufacturer's direct employee shall perform periodic inspections and provide a report to the engineer. Couplings installed that are not per manufacturer's guidelines will need to be replaced at the contractor's expense.

4. All grooved components shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, or IAPMO.
5. Grooved end product manufacturer to be ISO-9001 certified.
6. Certification Training:
   a. The installing contractor shall be certified by the grooved coupling manufacturer for the installation of their product. A manufacturer's factory trained representative (direct employee) shall provide on-site certification training for the installing contractor's field personnel in the use of grooving tools, application of groove, and product installation.
      1) A field training program must be designed, developed, administered and evaluated in accordance to the ANSI/IACET Standard for Continuing Education and Training. (IACET-International Association for Continuing Education and Training)
      2) All installation professionals and pipe fitters must be able to provide proof of successful course completion upon request.
7. Inspection Services: A factory trained inspector (direct employee) shall visit the job site and review grooved joint products installation. The installing contractor shall remove and replace any improperly installed products.
8. Upon completion of the manufacturer's inspection of the installation, the manufacturer may supply the owner with an extended warranty on the products at the manufacturer's discretion.

F. Stainless steel pipe shall be certified for use with the Vic-Press 304™ piping system. Pipe shall be square cut, +/-0.030", properly deburred and cleaned. Mark pipe ends at the required location using a manufacturer supplied gauge to ensure full insertion into the coupling or fitting during assembly. Use a Victaulic "PFT" series tool with the proper sized jaw for pressing.

G. Copper Press Piping Systems:
1. Copper Press joints shall be clean and free from scarring. Use press fittings, valves and specialties from a single manufacturer. Press tools must be approved for use by manufacturer.
2. Copper Press installer training: Contractor shall ensure each press installer has been trained on-site by a direct employee of the press fittings manufacturer in the use of press tools, and product installation. Contractor shall submit to the engineer documentation signed and dated by press fitting manufacturer, showing the names of the installers that have completed jobsite training.
3. Press fitting manufacturer inspections: A manufacturer's direct employee shall perform periodic inspections and provide a report to the engineer. Press Fittings installed that are not installed per the manufacturer's guidelines shall be replaced at the contractor's expense.
4. All press components shall conform to local codes and/or as listed by ANSI B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, IAPMO or ICC.
5. The press fitting product manufacturer is to be ISO-9001 certified.

3.02 TESTING OF PIPING

A. Supply all materials, labor, and power required for testing. Make preliminary tests and prove work satisfactory. Notify the Engineer in ample time to be present for final testing of all piping. Tests shall be made before insulation or concealing any piping.

B. Repair defects disclosed by tests or, if required by the Engineer, replace defective work with new work without additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted.

Make tests in stages to facilitate work of others. Use of wicking in tightening leaking joints is not permitted.

C. The Contractor shall be responsible for work disturbed or damaged by tests and/or repair and replacement of his work and shall cause work so disturbed or damaged to be restored to its original condition at no additional expense to the Owner.

D. Unless otherwise specified, all piping shall be hydrostatically tested to 150 psi. Tests shall be of 2-hours duration during which time piping shall show no leaks and during which time no sealing of leaks will be permitted. Any equipment not capable of withstanding test pressures shall be suitably isolated from test pressure.

E. For PP-R Piping: Hydrostatic testing and documentation of test results for polypropylene piping shall be in accordance with the manufacturer's written instructions and submitted to the manufacturer upon successful completion per warranty requirements.

3.03 PAINTING

A. Prior to insulation being applied, clean pipe and fittings of all rust, dirt, grease, etc. and coat rusted areas with a rust preventative paint “Rust Destroyer” by Advanced Protective Products, Inc., or approved equal. Also, refer to Section 23 00 00 - HVAC General for painting of ferrous hangers and supports.

END OF SECTION

SECTION 23 2116
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

1.02 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor materials, accessories, services, and equipment necessary to furnish and install all water specialties, as indicated and as specified herein.

PART 2 - PRODUCTS

2.01 EXPANSION TANKS

A. For each closed hydronic system, furnish and install vertical expansion/compression tank(s) of the capacity shown and specified herein. Acceptance volume shall be 100%.

B. The tank shell shall be fabricated from carbon steel and be designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division I.

C. The tank shall be fitted with a replaceable heavy-duty Butyl rubber bladder to isolate the air from the system fluid.

D. Tanks shall be factory charged to 12 psi and complete with lifting rings, system connection fitting (NPT), a 0.302"-32 charging valve (Schrader valve) and drain connection (NPT). Tanks shall be provided with a rust inhibitive factory prime coat. Vertical tanks shall have a steel floor mounting skirt.

E. Tanks shall be rated for 125 psig maximum working pressure and 270°F maximum operating temperature.

F. For projects located in California provide a factory installed sight glass.

G. Insulate tank(s) with 1" fiberglass insulation. Refer to Section 23 07 00 HVAC Insulation for additional information.

H. In areas requiring seismic restraint, provide manufacturer’s standard seismic restraint model. Install in accordance with manufacturer’s recommendations and local codes.

I. Expansion tanks shall be Bell & Gossett Series B Full Acceptance Pre-Charged Bladder Tank or equal by Taco, Wessels Co., or Armstrong provided they meet or exceed these specifications.

2.02 AIR SEPARATOR

A. For hot, chilled and any other closed loop water system, provide a full flow coalescing type combination air eliminator and dirt separator where shown on plan. Selection shall be based upon system flow with pipe size shown as a minimum. In no case shall the entering velocity exceed 6 feet per second.

B. The shell shall be fabricated from carbon steel and designed, constructed, inspected and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division I. The unit shall be rated for 125 psig maximum working pressure and 270°F maximum operating temperature.

C. The unit shall include internal coalescing elements filling the entire vessel to suppress turbulence and provide an air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 microns and larger within 100 passes. The elements shall consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed.

D. The vessel shall have two equal chambers above and below the inlet/outlet nozzles. The vessel diameter and height above and below the inlet/outlet connections shall be equal to the basis of design.

E. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber there shall be an integral full port float-actuated brass venting mechanism. Units shall also include a valved side tap (skimmer valve) to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

F. Do not make welds or other attachments to any part of the air separator.

G. Factory Options/Accessories:

1. Removable lower head for servicing internal components
2. Floor mount brackets (sizes 8" and larger)

H. Basis of design shall be Spirovent Series VDT or VHT as manufactured by Spirotherm, Inc. or approved equal. Optional Series VDN or VHN shall include removable lower head for internal inspection where scheduled. Equal products by Thrush will be considered provided they meet or exceed these specifications.

2.03 PRESSURE REDUCING VALVES

A. Pressure reducing valves shall meet the requirements of ASSE Standard 1003; (ANSI A112.26.2), CSA Standard B356 and be Certified by NSF to ANSI/NSF Standard 61-8.

B. Construction for sizes ½" thru 2" shall be:

1. Body: Lead Free copper silicon alloy
2. Seat:
   a. ½" thru 1" (15–25mm): Replaceable engineered polymer (10% glass filled Noryl)
   b. 1¼" thru 2" (32–50mm): Replaceable stainless steel
3. Integral Strainer: Stainless steel
4. Diaphragm: Reinforced EPDM with PTFE wetted surface
5. Valve Disc: EPDM

6. Temperature Range: 33°F – 160°F (0.5°C – 71°C)
7. Maximum Working Pressure: 300psi (20.7 bar)
8. Adjustable Reduced Pressure Range: 25 – 75psi (172 – 517 kPa)
9. Standard Reduced Pressure Setting: 50psi (345 kPa)

C. Acceptable manufacturers (provided they meet or exceed these specifications): Watts, Bell & Gossett, Apollo, and Cash Acme.

2.04 SAFETY RELIEF VALVES

A. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

C. Construction for sizes ¾" and 1" shall be:

1. Body: Bronze/Brass
2. Diaphragm and Seat: EPDM
3. Internal wetted parts: Brass
4. Maximum Working Pressure: 125 psig (8.6 bar)
5. Maximum Operating Temperature 250°F (121°C)

D. Construction for sizes 1½" and 2" shall be:

1. Body: Cast Iron
2. Diaphragm and Seat: EPDM
3. Internal wetted parts: Brass
4. Maximum Working Pressure: 50 psig (3.4 bar)
5. Maximum Operating Temperature 250°F (121°C)

E. Acceptable manufacturers (provided they meet or exceed these specifications): Watts, Bell & Gossett, Apollo, and Cash Acme.

2.05 AIR VENTS

A. Air vents shall be installed at the high points of closed loop hydronic piping systems.

B. Air vents shall be the serviceable type for inspection and replacement of internal components.

C. Air vents shall be fitted with either an integral check valve, integral shut-off valve or external shut-off valve to allow servicing without draining the system.

D. Construction for sizes ¼" thru ½" shall be:

1. Body: Brass
2. Float: Polypropylene or polyethylene
3. Mechanism stem: Brass
4. Mechanism Seal: EPDM
5. Seals: EPDM
6. Maximum Working Temperature: 240°F (115°C)
7. Maximum Working Pressure: 250psi (10 bar)
8. Maximum Vent Pressure: 60psi (4 bar)

E. Construction for size 3/4" shall be:

1. Body: Brass or Cast Iron
2. Float: Stainless Steel
3. Mechanism stem: Stainless Steel
4. Mechanism Seal: EPDM or Viton
5. Seals: EPDM
6. Maximum Working Temperature: 250°F (115°C)
7. Maximum Working Pressure: 230psi (10 bar)
8. Maximum Vent Pressure: 90psi (6 bar)

F. Acceptable manufacturers (provided they meet or exceed these specifications): Watts, Bell & Gossett, Caleffi, and Hoffman.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All water specialties as herein specified shall be installed and adjusted to suit the system needs and requirements. The installation shall be performed in strict accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING, INSULATION AND ACCESSORIES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. Refrigerant piping shall meet the requirements of the Safety Standard for Refrigeration Systems (ANSI/ASHRAE Standard 15-Latest Edition) and the Code for Pressure Piping (ANSI/ASME Standard B31.5-Latest Edition: Refrigeration Piping and Heat Transfer Components).

C. Piping, valves, accessories and insulation installed indoors shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install all refrigerant piping, insulating systems, and accessories, complete, as indicated and specified herein.

B. Without limiting the generality thereof, the work in this section shall include the following items:

a. Direct expansion (DX) system piping (cooling only and heat pump)
b. Variable Refrigerant Flow/Variable Refrigerant Volume (VRF/VRV) system piping
c. Insulating the following systems:
   1) Refrigerant suction (low pressure gas) piping
   2) Refrigerant hot gas (discharge or high-pressure gas) piping.
   3) Refrigerant liquid piping for VRF/VRV and Heat Pump systems.
   4) Refrigerant liquid piping for ductless split systems

1.03 RELATED DOCUMENTS

A. Specification sections:

1. 23 81 26 Split System Air Conditioners
2. 23 81 28 Ductless Split System Heat Pumps
3. 23 81 29 Variable Refrigerant Flow HVAC Systems

1.04 RELATED REFERENCES

A. Designation and Safety Classification of Refrigerants (ANSI/ASHRAE Standard 34-Latest Edition).

1.05 QUALITY ASSURANCE

A. Installer Qualification: Only trained and experienced installers skilled in refrigeration pipe installation and brazing of copper tubing shall be used.

B. Piping, valves and accessories shall be manufactured in the United States. Submit Certificate of Manufacture with shop drawings.

1.06 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, valve arrangements and locations, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Piping materials including Certificate of Manufacture

D. Insulation products, adhesives, coatings, etc. including Material Safety Data Sheets

E. Field quality-control test reports

F. Operation and maintenance data

1.07 PRODUCT STORAGE AND HANDLING

A. Store piping, insulation, valves and specialties in a clean and protected area.

B. Piping, tubes, and coils shall be stored with end caps in place to ensure that piping interior and exterior remain clean prior to installation.

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING

A. Piping shall be:

1. Type “L” hard drawn seamless copper tube conforming to ASTM B88, or
2. Type “ACR” (Air Conditioning and Refrigeration) service copper tubing conforming to ASTM B280.
   a. Straight Lengths: ASTM B 75, UNS C12200, H55 Temper (Light Drawn), ACR Bending Quality; Cleaned, Eddy Current Tested, and Plugged per ASTM B 280.
   b. Coiled: ASTM B 280, UNS C12200, O60 Temper (Soft Annealed), ACR, cleaned and capped. Coils shall be dehydrated, purged with Nitrogen and tightly capped to insure cleanliness. Piping shall be engineered and constructed to support R-410A to 700 psi @ 250°F.
      1) Acceptable manufacturers:
         a) Streamline/Mueller
         b) Reftekk, Inc.
         c) Linesets, Inc.
         d) ACR Green Proshield by Select Manufacturing, Inc.

e) JMF Company

B. Joints shall be brazed. Brazing filler metals shall comply with AWS A5.8. Mechanical press type joints are not allowed.

2.02 VALVES, FITTINGS AND SPECIALTIES

A. Fittings shall be wrought copper conforming to ASME/ANSI Standard B16.
B. Valves, filter-driers and other accessories shall be suitable for refrigerant service.

C. Field Swaged Brazing Cups: MSS-SP-73, ASME B 16.50

D. Field Bends (all angles): ASME B31.5

E. Full Port Refrigeration Service Valves:

1. Body: Forged brass uni-body style with brass cap including key end to remove core
2. Schrader service valve with cap
3. Core: Removable ball-type check valve with stainless-steel spring
4. Seat: Polytetrafluoroethylene
5. End Connections: Socket ends
6. Working Pressure Rating: 700 psig (factory tested)
7. Maximum Operating Temperature 300°F
8. Valves must be specifically rated for R-410A
9. Approved manufacturers: Diamondback, Parker, Mueller/Streamline

2.03 INSULATION

A. Refrigerant piping shall be insulated as follows:

1. Operating temperatures up to 220°F: flexible elastomeric tubing insulation (PVC/NBR), AP/Armaflex Black LapSeal™ pipe insulation as manufactured by Armacell, LLC or approved equal. All joints and seams shall be sealed weather-tight with Armaflex Black LapSeal™ Tape. Black LapSeal™ Tape shall also be used to secure the thermostat cable to the pipe insulation prior to applying the finish coat. The finish coat for flexible elastomeric insulation installed outdoors shall be two coats of a water-based latex paint designed for use over all forms of flexible elastomeric insulation. Finish coat shall provide a protective finish suitable to both indoor and outdoor applications, formulated for cold weather flexibility to resist cracking and weather-resistant to ultraviolet (UV) and ozone. Coating shall be Armaflex WB finish or equivalent product compatible with the insulation.
   a. Acceptable alternate products:
      1) Aeroflex, USA, Inc. Aerocell with Protape and two coats of field applied Aerocel Aerocoat.
      2) K-Flex Titan™ (no field applied protective coating required)
3. Operating temperature from 220°F to 257°F: Flexible Elastomeric Foam: EPDM - Closed cell expanded rubber. Comply with ASTM C 534, Type I for tubular materials for refrigeration pipe sizes 1/4" and greater.
   a. Outdoor Use: EPDM pre-split with lap seal and two coats of field applied UV and ozone resistant coating:
      1) Aeroflex, USA, Inc., EPDM Aerocel-SSPT with two coats of field applied Aerocel Aerocoat
      2) Armacell, LLC, EPDM UT SolaFlex, pre-split with lap seal and with two coats of field applied Armaflex WB

3) K-Flex Titan™ HT (no field applied protective coating required)

b. Indoor Use: EPDM pre-split with lap seal:

1) Aeroflex, USA, Inc., EPDM SSPT
2) Armacell, LLC, EPDM UT SolaFlex, pre-split with lap seal
3) K-Flex Titan™ HT

c. Applied to Annealed Coiled Tubing (Line Sets):

1) EPDM continuous tube
   a) Streamline/Mueller
   b) Reftekk, Inc.
   c) Linesets, Inc.
   d) ACR Green Proshield by Select Manufacturing, Inc.
   e) JMF Company
   f) K-Flex Titan

4. Fittings, valves and specialties shall be insulated with factory formed sectional units of the materials listed above.
5. Insulation that is outdoors and not directly exposed to sunlight (i.e. piping is enclosed in a prefabricated duct system) does not require the UV protective coating.
6. Valves and specialties shall be provided with a factory insulation package fabricated from materials listed above.
7. Insulating systems above are to be considered as a minimum. Air conditioning system manufacturer's recommendations take precedence over the insulation materials listed above.

B. Insulation thickness shall be as follows:

1. VRF/VRV Heat Pump and Heat Recovery Systems - Insulate all piping:
   (Note that some ductless split systems and multi-split systems may operate at these temperatures. Verify operating temperatures with the manufacturer)

VRF/VRV Refrigerant Piping Systems											
REFRIGERANT CONDITION or PHASE	REFRIGERANT TEMPERATURE RANGE (°F)	INSULATION MEAN RATING TEMPERATURE (°F)	ACR TUBING OUTSIDE DIAMETER								
			1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1-1/8"	1-3/8"	1-5/8"
			INSULATION THICKNESS REQUIRED (INCHES)								
HIGH PRESSURE VAPOR	201-250	150	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"
	141-200	125	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"	2"
LIQUID	105-140	100	1"	1"	1"	1"	1"	1"	1-1/2"	1-1/2"	1-1/2"
LOW PRESSURE VAPOR	40-60	75	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1"
	BELOW 40	50	1"	1"	1"	1"	1"	1"	1-1/2"	1-1/2"	1-1/2"
NOTE: FOR PIPING SMALLER THAN 1-1/2 INCHES AND LOCATED IN PARTITIONS WITHIN CONDITIONED SPACES, REDUCTION OF THESE THICKNESSES BY 1 INCH SHALL BE PERMITTED, BUT NOT TO THICKNESSES BELOW 1 INCH.											

ASHRAE 90.1-2010, ASHRAE 90.1-2013 & ASHRAE 90.1-2016

1. Traditional Cooling Only Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. All pipe sizes 1/2" insulation
2. Traditional Heat Pump Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. <1-1/2" pipe 1" insulation
   b. 1-1/2"<4" pipe 1-1/2" insulation
3. Mini-Split Cooling Only (TXV located at outdoor unit) – Insulate all piping – 1" insulation
4. Mini-Split Heat Pump (TXV located at outdoor unit) – Insulate all piping – 1" insulation

IECC 2012, 2015 and 2018 Commercial

1. Traditional Cooling Only Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. All pipe sizes 1/2" insulation
2. Traditional Heat Pump Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. <1-1/2" pipe 1" insulation
   b. 1-1/2"<4" pipe 1-1/2" insulation
3. Mini-Split Cooling Only (TXV located at outdoor unit) – Insulate all piping – 1" insulation
4. Mini-Split Heat Pump (TXV located at outdoor unit) – Insulate all piping – 1" insulation

PART 3 - EXECUTION

3.01 GENERAL

A. Refrigerant piping shall be supported as shown on the Drawings and as required at intervals not over 8'-0" O.C. and at all turns and offsets. Hangers and pipe clamps shall be copper plated tubing hangers of adequate size to fit around tubing and insulation as required. Saddles shall be used under insulated tubing to protect insulation. Piping routed in excess of 6 (six) lineal feet on the roof shall be supported by B-Line “Dura-Blok” rooftop supports or approved equal.

B. Pressure testing of piping systems shall be in accordance with standard industry practice for the refrigerant used.

C. Refrigerant piping shall be clean and free of outside contaminants at all times. Prior to start-up of any equipment or insulation installation, all piping shall be cleaned, tested, dehydrated and charged as recommended by the refrigerant compressor manufacturer.

1. Procedure: Joints and connections in refrigerant piping shall not be installed in partitions or walls or where inaccessible for testing, inspection and rework. Make provisions to prevent contact of dissimilar metals. During construction, cap all tubing to prevent moisture from entering. Keep in dry location.
2. Leak testing and recharging: Upon completion of installation of air conditioning equipment, test all refrigerant piping, components and accessories, including quick-connect refrigerant connectors for evaporator and condensing unit; test with a halide torch; prove tight by Contractor to assure a leak-tight refrigerant system. If leaks are detected at the time of installation or during warranty period, remove

entire refrigerant charge from system, correct leaks, and retest system. After system is found to be leak free, evacuation shall be accomplished by use of a reliable gauge and a vacuum pump capable of pulling vacuum of at least one mm Hg absolute. Accomplish system evacuation in strict accordance with equipment manufacturer's printed instruction. System leak testing, evacuation, dehydration and charging with refrigerant shall comply with standard industry practice and local codes and ordinances.

D. Refrigerant piping shall be run continuously, without joints, where possible. All joints in refrigerant piping shall be made accessible. Joints shall not be permitted in concrete slabs or below grade.

E. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps or shall be otherwise secured to prevent unauthorized access.

F. All piping shall be run true to grade and shall be arranged to make the best possible appearance. Except where otherwise required by conditions of installation, all piping shall be symmetrical and parallel with lines of buildings or structure in which it is installed. All piping shall be run concealed except in mechanical room and where indicated otherwise.

G. All piping and equipment shall be supported and guided. Anchors shall be provided to absorb or transmit thrust and eliminate vibration or pulsation. Hangers or supports shall be provided near each change of direction. Supports shall be so located or shall be of such type as not to unduly restrict the movement of the pipe due to lateral or longitudinal expansion.

3.02 PIPING APPLICATIONS

A. Suction (low pressure gas), Hot Gas (high pressure gas) and Liquid Lines 5/8" OD and Smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Copper, Type ACR, O60 (soft annealed)-temper tubing and field bent fittings with brazed joints.

B. Suction (low pressure gas), Hot Gas (high pressure gas), and Liquid Lines 2-1/8" OD and smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Straight Lengths, Copper, Type ACR Type L, H55 (light drawn)-temper tubing and field **bent fittings with brazed joints.**

3.03 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves as specified or as required to isolate system components.

3.04 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; route and size piping based on manufacturer's recommended line lengths and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15 (latest version).

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. Concealed locations shall be free of pipe joints.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping adjacent to machines to allow service and maintenance.

F. Install piping free of sags and bends.

G. Field bend changes in direction.

H. Select system components with pressure rating equal to or greater than maximum allowable working pressure.

I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

J. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section “Access Doors and Frames” if valves or equipment requiring maintenance is concealed behind finished surfaces.

K. Provide jacketed insulation in locations where exposed to mechanical injury.

L. When brazing, remove solenoid-valve coils and sight glasses; also, remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

M. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 00 00 HVAC General.

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 00 00 HVAC General.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 00 00 HVAC General.

Q. Provide proper compensation for pipe/tube expansion and contraction per equipment manufacturers recommendations.

3.05 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” Chapter “Pipe and Tube”.

1. Use Type BcuP-5 (15% Ag, 80% Cu, 5% P), copper-phosphorus alloy pre-formed brazing rings for joining copper swage fittings and copper socket fittings with copper pipe. Do NOT use flux.
2. Use Type Bag-5 (45% Ag), cadmium-free silver alloy for joining copper with bronze or steel. Use manufacturers recommended flux.

B. Field Swaged Brazing Cups: Fabricate brazing cup on one tubing end for each coupling. Only O60 (soft annealed) and H55 (light drawn) may be swaged. Do NOT swage H58

(drawn general purpose). Use swaging tool designed to provide a minimum of 0.0015" brazing gap and a maximum of 0.005" brazing gap. Brazing cup depth for each tube size shall be as follows:

1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1-1/8"	1-3/8"	1-5/8"	2-1/8"
0.250"	0.280"	0.310"	0.390"	0.420"	0.460"	0.510"	0.560"	0.600"	0.700"

C. Field Bends: Fabricate field bends with a center-line bend radius greater than or equal to 4 times the nominal OD of the pipe or tube. Tube shall be bent with a tubing bender sized for ACR OD tube sizes and shall not cause cracks or wrinkles in the tube or pipe. Do NOT use a conduit bender for bending ACR copper. The difference between maximum and minimum diameters for pipe bends should not exceed 8% of the nominal outside diameter of the pipe. Only O60 soft annealed-temper and H55 light drawn-temper shall be field bent. Do NOT field bend H58 drawn general purpose-temper copper tube.

D. Brazing and joining procedure:

1. Tube ends shall be cut with a clean sharp tubing cutter.
2. Deburr the I.D. of the cut tube end with a clean deburring tool.
3. Visually inspect the interior of each tube for obstructions and debris before assembly. Protect the joint from contamination before brazing.
4. Method of pre-cleaning: Non-shedding abrasive pads (Scotch Bright) to remove all oxides in the brazing area followed by wiping with a clean lint-free white cloth. Do not groove the surfaces while cleaning.
5. Purge all tubing with oil free nitrogen while brazing and until cool to the touch. Use an oxygen analyzer to verify the absence of oxygen prior to brazing. The oxygen content shall be less than 1% before start of brazing.
6. Use a neutral to slightly reducing flame using oxy/acetylene or oxy/propane.
7. Use the proper torch tip based on tube size as recommended by the torch manufacturer. Use of Turbo-Torch or Rosebud is permitted.
8. Post Brazing Cleaning: Exterior of all completed joints shall be washed with a water-soaked rag or sponge, followed by brushing with a stainless-steel hand wire brush to remove any residue for inspection.

3.06 HANGERS AND SUPPORTS

A. Piping hangers and supports must accommodate expansion and contraction, vibration, dead load of piping and its contents, and seismic-bracing requirements.

B. Install the following pipe attachments or combination thereof:

1. Adjustable steel clevis hangers for individual horizontal runs.
2. Channel strut or angle iron trapeze for multiple horizontal runs
3. Galvanized steel saddle with attachment screw for channel strut applications
4. Rigid high compressive strength foam insulating pipe support at all clamps and support points.
5. Rigid high compressive strength foam pipe support at all riser clamps.
6. Do NOT attach hangers directly to pipe or tube.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. Up to 3/4" OD: Maximum span, 60 inches; minimum rod size, 3/8 inch.
2. Greater than 3/4" thru 1" OD: Maximum span, 72 inches; minimum rod size, 3/8 inch.

3. Greater than 1" thru 2-1/8" OD: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multi-floor vertical runs every 10 feet and at least at each floor with riser clamps.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test as follows or as recommended by the equipment manufacturer's installation instructions:
   a. Line Test Pressure for Refrigerant R-410A:
      1) Suction (low pressure gas) Lines: 550 psig, or per equipment manufacturers recommendation.
      2) Hot-Gas (high pressure gas) and Liquid Lines: 550 psig, or per equipment manufacturers recommendation.
3. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   a. Fill system with 95/5 nitrogen/hydrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test all joints and fittings with hydrogen leak detector, at test pressure.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.08 SYSTEM CHARGING

A. Charge system using the following procedures and per equipment manufacturer's installation instructions.

1. Evacuate (triple evacuation procedure) entire refrigerant system with a vacuum pump to obtain a steady state vacuum of less than 500 micrometers. If vacuum holds for 12 hours, system is ready for charging. Do NOT evacuate the system through a charging manifold. Use only suction rated hoses and core removal tools.
2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
3. Charge system as recommended by equipment manufacturer.

3.09 OWNER REVIEW OF MAINTENANCE REQUIREMENTS

A. Review manufacturer's maintenance instructions with the owner's representative to make them aware of any reoccurring maintenance requirements such as recoating piping insulation, lubricating service valves, etc.

END OF SECTION

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SECTION 23 3100
DUCTWORK AND ACCESSORIES

PART 1 – GENERAL

1.01 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 0000 - HVAC General.

B. Furnish and install all material, labor, accessories, etc. shown on the drawings and as specified herein to completely install all ductwork systems.

C. Ductwork systems shall be classified as follows:
   1. Static pressure class +2" W.G. - from constant volume air handling unit, and terminal unit to supply diffusers, and all return and exhaust ductwork
   2. Static pressure class +6" W.G. - from VAV air handling unit to PIU/VAV

D. Ductwork shall be constructed according to the latest edition of SMACNA ductwork construction standards applicable to the system pressures described above, and the system material construction.

E. Duct sizes shown on the drawings are nominal inside clear.

PART 2 – PRODUCTS

2.01 DUCTWORK

A. All ductwork shall be constructed of galvanized steel sheets of the thickness listed in the SMACNA manuals for the pressures referenced above.

2.02 FIRE DAMPERS

A. Type B or C fire dampers with the blade stack out of the airstream shall be installed at all locations where ductwork penetrates any floor, wall or partition with a fire rating of 1 hour or more and where otherwise shown on the drawings. Fire dampers shall have a rating compatible with the floor, wall or partition, and shall be UL 555 rated. Type A fire dampers with the blade stack in the airstream may be used behind grilles or where space conditions do not permit the use of a Type B damper.

B. All fire dampers shall be of the “Dynamic” type as classified in UL Standard 555.

C. Slab, Wall and Partition Dampers
   1. Dampers shall be factory built curtain type. They shall conform to the requirements of NFPA Standard 90 and be UL labeled for the required rating (1-1/2 hour minimum).
   2. Provide factory built sleeves of design and length to permit mounting within the opening.
   3. All dampers shall be installed in strict accordance with the manufacturer’s UL approved installation.

2.03 FLEX DUCT CONNECTORS

A. Install flex duct connectors at connections of sheet metal duct to motor driven equipment, or otherwise noted. Flex duct connectors shall be glass fabric coated with neoprene, suitable for service. Install per manufacturer’s instructions, and support sheet metal ductwork so that no weight is supported by flex duct connector.

B. Flex duct connectors shall also be provided at building expansion joints.

2.04 ACCESS DOORS

A. Hinged, gasketed and latched access doors and/or panels shall be installed at each fire and smoke damper, each duct mounted smoke detector, each valve, at each duct mounted balancing damper or any other mechanical equipment or device that requires accessibility. Doors and panels shall be sized and located to optimize access to dampers, detectors, and other equipment for service and replacement. Access doors in ductwork shall be per SMACNA Standards. Access doors and panels in walls, ceilings or other surfaces shall be coordinated with architectural finishes, and shall be as manufactured by Cesco Products.

2.05 FLEXIBLE DUCTWORK

A. Flexible ductwork shall be UL Class I air duct.

B. Flexible ductwork (maximum 6'-0" long) shall be installed between main supply ducts and diffusers.

C. Take-offs shall be made using spin-in type fittings with scoop and balancing damper. Flexible ductwork shall be Thermaflex M-KE R-6 (R value = 6.0 minimum or as required by local energy code) flexible air duct or approved equal. Duct size shall be the same size as diffuser neck it serves.

D. Flexible duct connections to ceiling diffusers shall be installed without kinks or sags to provide unrestricted airflow. Provide Flex Flow Elbow supports by Thermaflex.

2.06 AUTOMATIC CONTROL DAMPERS

A. Automatic control dampers shall be installed as shown on the drawings and shall be controlled as described in the 23 0900 - Instrumentation and Control for HVAC section of these specifications.

B. Dampers shall be of the opposed blade type constructed of minimum 18-gauge galvanized steel and shall have rigidly constructed blades less than 6" wide, and shall have duct mounting flanges.

C. Dampers shall be of the low leakage type with replaceable blade and jamb seals. Damper leakage shall not exceed 6 cfm per sq. ft. of damper area at 4 in. w.c.

2.07 DUCT INSULATION

A. Refer to Section 23 0700 - HVAC Insulation.

2.08 SMOKE DAMPERS

A. Smoke dampers with airfoil shaped blades shall be installed at all locations where ductwork or supply or return air openings penetrate any floor, wall or partition with a smoke rating, or where otherwise shown on the drawings, except where such ductwork or openings are part of an engineered smoke removal system. Smoke dampers shall have a rating compatible with the floor, wall, or partition, and shall be Class I, UL555S rated.

B. Smoke dampers shall be provided with actuators capable of closing the damper on activation of area smoke detectors or fire alarm system, and shall be normally closed. Wiring of actuators shall be by the mechanical contractor. Actuators shall be compatible with activating smoke detectors or fire alarm system (coordinate with other trades).

PART 3 – EXECUTION

3.01 DUCTWORK

A. All ductwork shall be installed in accordance with applicable SMACNA Standards according to the pressure class described in PART 1 - GENERAL.

B. Ductwork shall be supported as recommended by SMACNA Standards from structural members. Ductwork shall not be allowed to rest on ceilings, light fixtures or structural members. Ductwork supported from joists shall be supported from the <u>top</u> chord of all joists.

C. All ductwork accessories shall be installed in strict accordance with manufacturer's recommendations.

D. All ductwork shall be cleaned inside and out prior to system start up, and shall be left in a neat and orderly manner.

E. Ducts, unless otherwise approved, shall be true to dimensions indicated, straight and smooth on inside with neatly finished joints; securely anchor to building in an approved manner, and install to be completely free from vibration under all conditions of operation. Exact routing of ductwork will be dependent on location of framing members. Route duct to avoid cutting framing members. Duct sizes shown on drawings are inside clear dimensions.

F. Brace ducts not more than 60 inches on center. Make slip joints in direction of flow. Unless otherwise indicated, elbows shall have a centerline radius of not less than 1 ½ times the width of the duct. Where space limitations necessitate use of short radius or square elbows, install turning vanes. Offset ducts around obstructions where possible. Where duct must encompass obstruction, area of duct shall remain constant. Duct tapers shall not exceed 1:4 ratio and transformations 30 degrees between air flow and diverging or converging air flow. Provide access doors for access to all equipment, dampers and motors concealed by sheet metal.

3.02 DAMPERS

A. Install dampers where indicated on drawings. Provide friction damper behind face of each supply outlet which shall be adjustable through the face of the grille with a screwdriver.

END OF SECTION

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SECTION 23 3400
UNITARY EXHAUST AND SUPPLY FANS AND VENTILATORS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Refer to specification section 23 0000 - HVAC General, all of which applies to work described in this section as if written in full herein.

B. Furnish and install all unitary exhaust and supply fans and ventilators of the size, type, capacity and characteristics as shown on the equipment schedules and herein described.

C. Acceptable manufacturers shall be Greenheck, Penn-Barry, Cook, or approved equal and shall include only those whose products have been in satisfactory use in similar service for not less than five (5) years.

D. Electrical Standards: Provide electrical motors and products which have been listed and labeled by Underwriters Laboratories Inc. and comply with NEMA Standards.

E. Certification, Fan Performance: Provide fans whose performance is certified by AMCA under the specified conditions.

PART 2 – PRODUCTS

2.01 CENTRIFUGAL AND AXIAL FANS AND VENTILATORS

A. All units shall be rigidly constructed of materials suitable for the intended service and shall be installed with all accessories listed on the Drawings.

B. All roof mounted units shall be installed on factory supplied 12-inch high (minimum) insulated roof curbs of the proper type, size and construction for proper mounting. Curbs shall account for all roof slopes and pitches so that the unit is installed level. Units shall be anchored to curbs by a minimum of two lag screws of adequate size on each side. Curbs shall be constructed of galvanized steel, except when the project is located within 5 miles of a sea coast they shall be of aluminum construction.

C. Outdoor fans shall be completely weatherproof for outdoor installation and shall contain internal vibration isolation to assure smooth and quiet performance.

D. Fan wheels and blades shall be constructed of aluminum and shall be statically and dynamically balanced at the factory.

2.02 CEILING-CENTRIFUGAL AND CABINET FANS

A. Units shall be direct-drive type with back-draft damper, acoustically insulated cabinets and speed controller.

PART 3 – EXECUTION

3.01 GENERAL

A. All units shall be installed in accordance with manufacturer’s recommendations and as shown on the Drawings.

B. Ceiling-centrifugal and cabinet fans shall be supported from structural members and shall not rest on the ceiling, on lights or on structural members.

C. Units shall be interlocked and controlled as indicated on the Drawings.

D. Ceiling-mounted units shall be installed with ceiling grilles flush with the ceiling.

E. Curb-mounted fans shall be secured to the roof curb with lag screws in each hole in the fan curb cap.

F. Electrical connection to the fan motor shall be made through the roof opening inside the roof curb.

END OF SECTION

SECTION 23 3700
LOUVERS, GRILLES, REGISTERS AND DIFFUSERS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install all louvers, grilles, registers and diffusers of the size, type, capacity, and characteristics as shown on the equipment schedules and described herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

PART 2 – PRODUCTS

2.01 LOUVERS

A. Louver components (heads, jambs, sills, blades, etc.) shall be factory assembled by the manufacturer into a complete unit. Louver sizes too large for shipping shall be built-up by the Contractor from factory assembled louver sections to provide the overall sizes required.

B. Louver design shall incorporate structural supports required to withstand wind loads applicable to specific project site location design wind speeds, but in no case less than 20 lbs. per square foot.

C. All louver performance data submitted for approval shall bear the AMCA Certified Ratings Seal for Air Performance and Water Penetration.

D. All louvers shall have a standard factory applied finish coating with color selection made by the Architect at the time of shop drawing approval. Color charts shall be submitted with louver shop drawings.

E. Louvers shall be as manufactured by Greenheck, Ruskin, Arrow, United Enertech, or approved equal.

2.02 GRILLES, REGISTERS AND DIFFUSERS

A. Units shall be of the type, size, and construction as scheduled on the drawings.

B. Unless otherwise noted on the drawings, all units shall be supplied with a factory finish of white baked enamel.

C. Grilles, registers and diffusers shall be ordered with borders compatible with the ceiling system type in which they are installed.

D. Aluminum devices shall be used for all areas subject to excessive moisture or humidity (e.g. bathrooms, etc.).

E. Air devices shall be as manufactured by Titus, Price, Nailor, Krueger, MetalAire, or approved equal.

PART 3 – EXECUTION

3.01 LOUVERS

A. Louvers shall be installed according to manufacturer's recommendations, and shall be caulked and sealed at the frame and flanges to make the installation weatherproof.

B. Combination louver dampers shall be installed with required damper operators and linkage mechanisms and shall be field adjusted for full opening/closure stroke. Louvers shall be interlocked as indicated on the drawings.

3.02 GRILLES, REGISTERS AND DIFFUSERS

A. All units located in ceiling tiles shall be centered or shall be on quarter points of 2 ft. x 2 ft. tiles.

B. Where a line of sight allows the ductwork, wall or ceiling structure to be seen behind any units, such ductwork, wall or ceiling structure shall be painted with nonflammable flat black paint to minimize visibility.

C. All units not installed on T-bar ceiling grids shall be securely fastened to adjacent structures.

D. Where air distribution devices are installed in inaccessible ceilings, provide spin-in with scoop without volume damper. Provide opposed blade damper in neck of air distribution device with access to damper control through face.

END OF SECTION

SECTION 23 7217
ENERGY RECOVERY UNIT HEAT PUMP

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 00 00 - HVAC General.

B. Furnish and install factory assembled, piped and wired packaged 100% outside air energy recovery dehumidification units of the size, type, capacity and characteristics as shown on the equipment schedules and herein described. All units shall be by the same manufacturer. The manufacturer shall have available factory trained service engineers and an inventory of replacement parts within a 100-mile radius of the job site.

C. Equipment schedules and specifications are intended to establish a minimum level of quality and workmanship for the project. When other than the basis of design equipment is proposed, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

D. Refer to the drawings for basis of design manufacturer, accessories, and acceptable alternates.

E. Substitution Request: Manufacturers of alternate equipment must be approved to bid via addendum, in writing by the specifying Engineer, at least two (2) weeks prior to bid time in order for their bid to be accepted. Substitution request form from the Division 01 specifications shall be submitted to the Architect along with supporting data citing any deviations from the contract documents. Refer to paragraph C. above.

F. The manufacturer must have been a manufacturer of packaged energy recovery equipment for at least five (5) years prior to bid time.

1.02 SUBMITTALS

A. Submittal documents shall be prepared by the manufacturer in accordance with Division 01 requirements.

B. Submittal package shall include the following as a minimum:

1. Data sheets for all system components
2. Fan selections with performance curves at site conditions
3. Energy recovery section data and performance
4. Storage and handling requirements and recommendations
5. Electrical characteristics
6. Wiring diagrams
7. Installation, Operation and Maintenance manual
8. AHRI Rating Certificates for actual equipment to be installed
9. Manufacturer’s warranty
10. Sound-power level ratings
11. Seismic bracing
12. High wind rated curb and methods for securing to structure and securing the RTU to the curb

C. Shop Drawings: Detailed equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

1.03 SYSTEM DESCRIPTION

A. Outdoor roof curb or slab mounted, electronically controlled, cooling or cooling/heating unit utilizing hermetic scroll compressors with crankcase heaters for cooling duty and electric resistance heaters for heating duty. Units shall discharge supply air vertically or horizontally as shown on contract drawings.

1.04 QUALITY ASSURANCE

A. Unit shall be designed to conform to the latest adopted editions of ANSI/ASHRAE 15, ASHRAE 62, and UL Standard 1995.

B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, “Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.”

C. Energy recovery heat wheel performance shall be certified and listed in AHRI-1060 (I-P) Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
   1. Capacity ratings for air-to-air energy recovery equipment shall comply with AHRI 1060, “Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.”
   2. Capacity ratings for air coils shall comply with AHRI 410, “Forced-Circulation Air-Cooling and Air-Heating Coils.”
   3. The rooftop unit(s) shall be certified in accordance with UL Standard 1995 and ANSI Standard Z21.47.
   4. The rooftop unit(s) shall be safety certified by a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, intertek, QAI, etc.) and the nameplate shall carry the label of the certification agency.

E. All wiring shall be in accordance with the National Electrical Code (NEC).

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (NEC), Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for their intended use.

G. Unit shall be approved for use in and outside High Velocity Hurricane Zones (HVHZ) by the Florida Building Code (FL# 15031), when using the required steel rooftop curb and attachment methods. Maximum allowable lateral wind pressure is +100psf/-100psf. Maximum allowable uplift is +50psf/-50psf. Positive and negative required design pressures calculated for use with this system shall be determined by others on a job specific basis, in accordance with the governing code. Site specific pressures shall be less than or equal to the listed positive or negative allowable lateral wind design pressure and allowable uplift values for the product.

H. The manufacturer shall ensure replacement parts are available for a minimum of ten (10) years from the date of project turnover to the owner.

I. Unit shall be listed as a total package by ETL and ETL, Canada.

J. Roof curb shall be designed to NRCA criteria per Bulletin B-1986.

K. K.Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver units as factory-assembled units with protective crating and covering as recommended by the manufacturer.

B. Coordinate delivery of units in enough time to allow movement into building.

C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.06 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with structure. Roof specialties are specified in Division 07 sections.

B. Coordinate with all trades prior to ordering equipment for required connections to utilities.

1.07 WARRANTY

A. A written warranty shall be executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.

1. Warranty Period - Rooftop/Air Handling Unit: Manufacturer's standard, not less than one (1) year after date of startup.
2. Warranty Period - Compressors: Manufacturer's extended 5-year warranty, parts only.
3. Warranty Period – Gas-Fired Heat Exchangers: Manufacturer's non-prorated full parts replacement not less than 10-years from date of shipment.
4. Warranty Period – Total Energy Recovery Wheel: 5-year warranty, parts only commencing on date of start. The warranty is for all wheel cassette components except the drive motor, which shall be warranted by the motor manufacturer.

PART 2 — PRODUCTS

2.01 EQUIPMENT

A. General:
The unit shall be a packaged factory assembled heating and/or cooling system. The unit shall consist of all factory wiring with a single point power connection, refrigerant piping and charge (R-410A), operating oil charge, single refrigerant circuit (sizes 036–096) or dual refrigerant circuits (sizes 120–840), with a microprocessor based control system. The unit shall, based on project requirements, include all special features necessary to provide fully conditioned ventilation air at neutral conditions to the building.

B. Unit Cabinet:
1. Double wall design, constructed of G-90 galvanized steel, bonderized and pre-coated with a polyester pre-coat finish.
    a. Top cover shall be a minimum of 18-gage sheet metal with 2.0-in. thick, closed cell polyisocyanurate foam R13 insulation with a 24-gage sheet metal interior liner.

b. Access panels and doors shall be a minimum of 20-gage sheet metal with 2.0-in. thick, closed cell polyisocyanurate foam insulation with a 24-gage sheet metal interior liner. Access doors shall be equipped with stainless steel hinges and quarter turn, adjustable, draw tight cam-action latches.

c. Corner and center posts shall be 16 or 18-gage galvanized steel, insulated

d. Base pans shall be 16 or 18-gage galvanized steel. All openings through the base pan shall have upturned flanges at least 0.5 inches in height.

e. Base pans shall be insulated with 0.375-in. thick closed cell foam insulation.

f. Condensate pan double sloped shall be 20-gage stainless steel insulated with closed cell neoprene insulation.

g. Base rail shall be double flanged 12-gage galvanized steel or welded closed section structural steel tubing.

h. Roof sections shall be sloped for proper drainage.

2. Unit casing shall be capable of withstanding 1000-hour salt spray exposure per ASTM B117.
3. Unit shall have insulated access doors, hinged for easy access to the controls compartment and all other areas requiring servicing. Each door shall seal against a triple edge co-extruded EPDM gasket to help prevent air and water leakage and for ease and safety during servicing. Access doors shall include a thermal break.
4. Interior cabinet surfaces shall be lined with 24 gage galvanized steel.
5. Unit shall have a factory-installed sloped condensate drain connection fabricated of stainless steel with welded corners and drain connection.
6. Unit shall be equipped with fittings in frame rails to facilitate overhead rigging.
7. Filters shall be accessible through a hinged access panel.
8. The outdoor air opening shall have a factory provided hood with bird screen.

C. Fans:

1. Indoor Evaporator Fans:

a. Direct-drive Plenum fan(s) shall be provided and both axial and radial clearances must be equal to or greater than fan manufacturer's recommendations for full rated fan performance and efficiency.

b. Base mounted and external rotor fans with EC motors shall be statically and dynamically balanced at the factory as a single rotating assembly to a quality level of G=2.5 in accordance with DIN ISO 1940-1.

2. Condenser Fans:

a. Fans shall be external rotor direct driven axial fans with a minimum 5-1/2" spun venturi for high efficiency and low noise, with cast profiled blades.

b. The fan motor assembly shall be end mounted to a structurally rigid welded finger guard.

c. Fans shall discharge air vertically upward and the finger guard shall be powder coated.

d. Fans shall be statically and dynamically balanced as an assembly to a quality level of G=6.3 in accordance with DIN ISO 1940-1.

D. Compressors:

1. A digital compressor shall be available for lead or both refrigeration circuits. A Digital Control Module (DCM) shall be included. The control system shall be capable of

unloading the compressor in an unlimited number of steps from 100% capacity down to 10% capacity

2. Fully hermetic, scroll type compressors with overload protection and short cycle protection with minimum on and off timers.
3. Compressor shall be installed in an insulated compartment accessible thru hinged access doors, isolated from the treated air stream.
4. Line voltage controls, operating controls, refrigerant circuit access points, refrigerant flow control devices and compressors shall be accessible from a single location behind left and right hinged access doors for ease of service.
5. Compressors shall be mounted on rubber in shear isolators and refrigerant lines to include reaction torque loops.
6. Reverse rotation protection shall be provide or all compressors.
7. Crankcase heaters shall only be activated during compressor off mode.

E. Coils:
1. Standard evaporator coil shall have enhanced surface aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with brazed tube joints.
2. Evaporator coils shall be minimum four (4) rows. Optional six (6) row coils shall are available.
3. Standard condenser coil shall have enhanced surface aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with brazed tube joints. Condenser coil with 1,2 and 4 fan option shall be microchannel.
4. Coils shall be pressure tested at 650 psig prior to unit assembly; leak tested at 150 psig with a final test at 475 psig.
5. Optional coil coatings for corrosion protection shall be available.

F. Refrigerant Components:
1. Unit shall be equipped with single refrigerant circuit (sizes 036–096) or dual refrigerant circuits (sizes 120–840, with each circuit containing:
   a. Solid core filter drier.
   b. Field adjustable externally equalized thermostatic expansion valve.
   c. Minimum load valve (Optional hot gas bypass).
   d. Service access ports
2. Unit shall be equipped with VFD-controlled variable condenser fan speed low ambient head pressure control to allow operation down to 35° F.

G. Filter Section:
Standard filter section shall be supplied with 2-in. thick MERV-8 pleated media filters.

H. Controls and Safeties:
1. Microprocessor Controls:
   a. Capacity is modulated by digital compressor unloading on single circuit and by sequencing and digital unloading on dual circuit systems
   b. Shall include a field-installed space temperature sensor with communication port.
   c. BACnet and Modbus. LonWorks protocol capable (Requires optional card).
   d. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1, energy standard.
   e. Shall provide an alarm indicator and an audible alarm signal.
   f. Shall provide and display a current alarm list and an alarm history list.
   g. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) shall be provided.
   h. Shall have service run test capability
   i Shall have a service diagnostic mode.

J. Unit shall be complete with self-contained low voltage control circuit.

2. Safeties:

a. Unit shall incorporate a solid-state compressor lockout which provides optional reset capability at the space thermostat should any of the following safety devices trip and shut off compressor:

1) Compressor lockout protection provided for either internal or external overload.
2) Low-pressure protection.
3) Freeze protection (evaporator coil).
4) High-pressure protection.
5) Loss of charge protection.

b. Supply-air sensor shall be located in the unit and shall be used for compressor stage control.

c. Unit shall be equipped with a supply fan status switch to protect the system in the event of a fan drive failure.

d. Induced draft heating section shall be provided with the following minimum protections:

1) High-temperature limit switch.
2) Differential pressure switch for proof of induced draft.
3) Flame rollout switch.
4) Flame proving controls.
5) Redundant style gas valve.

I. Operating Characteristics:
1. Unit shall be capable of starting and running at 115° F. outdoor ambient air temperature per maximum load criteria of AHRI Standard 340/360.
2. Unit with standard controls will operate in cooling down to an outdoor ambient temperature of 35° F.
3. Units shall be equipped with a motorized two position outdoor air (OA) damper for 100% OA operation.
4. Units can be equipped with an enthalpy control economizer.
5. Unit shall be provided with fan time delay to prevent cold air delivery (gas heat only).

J. Electrical Requirements:
1. All unit power wiring shall enter unit cabinet at a single location with a single power point connection.
2. Control panel shall incorporate “Touch-safe” design.

K. Motors:
1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have either internal line break thermal and current overload protection or external current overload modules with compressor temperature sensors.
2. All condenser fan motors shall be totally enclosed air-over (IP54) with permanently lubricated ball bearings, class F insulation and manual reset overload protection.
3. All indoor fan motors shall meet the minimum efficiency requirements as established by the Energy Policy Act of 1992 (EPACT), effective October 24, 1997.
4. Standard indoor fan motors shall be open drip proof design. Optional totally enclosed fan-cooled motors (non- ECM) are available.

L. Special Features:
Certain combinations of features are not available and are noted with an *.
1. Hot Gas Reheat:

A factory-installed hot gas reheat (HGRH) coil shall be available. The HGRH coil shall be available on the lead circuit only or with a second coil for reheat both refrigerant circuits. Units with HGRH will have variable speed low ambient head pressure control. Cycling or modulating HGRH shall be available.

2. Energy Recovery:
    a. The factory-installed enthalpy wheel shall be certified to meet the requirements of AHRI Standard 1060 and shall be AHRI listed.
    b. The enthalpy wheel shall be constructed of corrugated synthetic fibrous media with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media.
    c. The desiccant material shall be molecular sieve, 4 angstrom or smaller.
    d. The rotor shall be constructed of alternating layer of flat and corrugated media.
    e. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass.
    f. The wheel frames shall be evenly spaced steel spokes with a galvanized steel outer band and rigid center hub.
    g. The wheel seals shall be full contact nylon brush type.
    h. The wheel shall slide out of the cabinet side for service.
    i. Wheel cassettes shall be constructed of galvanized steel. Cassettes shall have integral purge section.
    j. The wheel bearings shall be inboard mounted permanently sealed roller bearings or externally flanged bearings.
    k. The wheel shall be driven by a fractional horsepower AC motor via a multilink drive belt.
    l. Energy wheel defrost control and air bypass shall be available.
    m. The wheel motor control by VFD is available as an option for frost control

3. Electric Heat:
    a. Electric resistance heaters shall be factory-installed, nichrome element type, open wire coils with 0.375 in. inside diameter, insulated with ceramic bushings, and include operating and safety controls. Coil ends shall be staked and welded to terminal screw slots.
    b. Factory-installed electric heat shall have:
        1) Staged heat control (1, 2 or 4 stages) or,
        2) SCR (silicon controlled rectifier) control providing infinite capacity adjustment..
4. Modulating Supply Fan(s):
   Package shall include a VFD controlled supply fan. VFD control shall be based on discharge duct pressure. Fan shall be:
   a. Rigid-mount for optimal performance
   b. Rubber pad isolation mount
   c. Installed on a slide-out deck that is removable for maintenance and service.
5. Liquid Subcooling Coil:
   The unit could be equipped with a factory-installed liquid sub-cooling coil on all circuits. The coil shall be located immediately downstream of the evaporator coil. Coil circuit(s) shall be switchable. Operation of sub-cooling coil shall produce between 6 and 10° F. reheat.
   Note: Sub-cooling coils are not available on heat-pump models
6. Modulating Exhaust Fan(s):
   Package shall include a VFD controlled exhaust fan. VFD control shall be based on building pressure. Fan shall be:

a. Rigid-mount for optimal performance
b. Include rubber vibration isolation
c. Installed on a slide-out deck that is removable for maintenance and service.

7. Supply and Exhaust Fan Motors:
   Motors shall be selected based on brake horsepower to meet system total static pressure.
8. Liquefied Propane (LP) furnaces:
   LP furnaces shall be factory-installed and do not require field conversion as a factory option.

9. Convenience Outlet:
   Shall be factory-installed and internally mounted with an externally accessible 115-v, 15 amp GFCI, female receptacle with hinged cover. The outlet shall require field-supplied 115-v power supply wiring. Factory-wired GFI with a step-down transformer and 15.0 Amp breaker is also available.
10. NEMA 3R Non-Fused Disconnect Switch:
    Shall be factory-installed, externally mounted, and UL approved. Non-fused switch shall provide unit power shutoff. Shall be accessible from outside the unit and shall provide power off lockout capability.
11. Integral Rotary Non-fused Disconnect Switch:
    Shall be factory-installed, internally mounted, and UL approved. Non-fused switch shall provide unit power shutoff. Shall be accessible from outside the unit on the control panel access door and shall provide power off lockout capability.
12. Firestat:
    A factory-installed, manual-reset firestat shall be mounted in the return air opening of the unit. The firestat shall be set to open at 135 F.
13. Dirty Filter Status Switch:
    The manual reset filter status switch shall be a pressure differential switch and will indicate a dirty filter. The switch shall be factory installed.
14. Fan Status Switch:
    The unit shall be equipped with a field-adjustable differential air pressure switch installed across the filters or supply fan to provide proof of airflow.
15. Phase/Voltage Monitor:
    A factory-installed under-voltage and phase loss sensor shall stop the unit whenever voltage is too low, phases are out of sequence, or a phase is dropped. The unit will restart automatically within five minutes after the correct power is supplied.
16. 4-Inch Filters:
    a. Optional filter section shall be supplied with 4-in. thick MERV-8, 11, or 14 pleated media filters.
    b. Optional filter section shall be supplied with 2” MERV-8 pre-filter plus 4” MERV 8, 11, or 14 type filters.
    c. Optional filter section shall be supplied with 2” metal mesh pre-filter plus 4” MERV 8, 11, or 14 type filters.
17. Digital Compressor(s):
    A digital compressor shall be available for lead or both refrigeration circuits. A Digital Control Module (DCM) shall be included. The control system shall be capable of unloading the compressor in an unlimited number of steps from 100% capacity down to 10% capacity.
18. Commissioning User Interface:
    The commissioning keypad/display unit (BACview) shall have a numeric keypad, direction keys, and programmable function keys. Display shall be a 4 line by 40 character backlit LCD display.
19. Full Perimeter Roof Curb:
    Curb shall be formed of minimum 14-gage galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
20. Corrosion Protection

Unit shall be equipped with a factory applied “Harsh Environment Protection” designed to combat the corrosive effect of industrial and commercial atmospheric conditions including salt air, salt water, acid rain, chlorine and chlorides hydrochloric, nitric, hydrofluoric, sulfuric and uric acid fumes, hydrogen sulfide gas, lye, sulfur dioxide, chlorides, methane gas, hydrocarbons, chlorinated solvents and aromatic solvents. The Harsh Environment Protection shall include the following features, where applicable, to provide extra protection against corrosive atmospheric conditions:

a. Coated refrigerant to air condenser for Harsh Environment, rated for 10,000 hr. Salt Spray
b. Coated refrigerant to air evaporator for Harsh Environment, rated for 10,000 hr. Salt Spray
c. Coated refrigerant to air hot gas reheat coil for Harsh Environment, rated for 10,000 hr. Salt Spray
d. Coated refrigerant to air sub-cooling coil for Harsh Environment, rated for 10,000 hr. Salt Spray
e. All exterior and interior cabinet panels shall be coated for Harsh Environment, rated for 10,000 hr. Salt Spray.

2" Pleated Surface, Farr 30/30 (MERV 8)
2" Metal Mesh
4" Pleated Surface, 30/30 (MERV 8)
4" Pleated Surface, 65% (MERV 11)
4" Pleated Surface, 95% (MERV 14)
2" FAR 30/30 (MERV 8) + 4IN 30/30 (MERV 8)
2" FAR 30/30 (MERV 8) + 4IN 65% (MERV 11)
2" FAR 30/30 (MERV 8)+ 4IN 95% (MERV 14)
2" Metal Mesh + 4IN 30/30 (MERV 8)
2" Metal Mesh + 4IN 65% (MERV 11)
2" Metal Mesh+ 4IN 95% (MERV 14)

END OF SECTION

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SECTION 23 7400
SINGLE PACKAGE ROOFTOP AIR CONDITIONERS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install factory assembled, piped and wired single package rooftop air conditioners of the type, operational characteristics and capacity as shown and scheduled and as specified herein. All rooftop units shall be by the same manufacturer. The manufacturer shall have available factory trained service engineers and an inventory of replacement parts within a 100-mile radius of the job site.

B. Compressor shall be warranted against parts failure for five (5) years.

C. Submit catalog cuts, certified performance data, and dimensional data.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Unit shall be designed specifically for outdoor installation with all exterior surfaces of phosphatized, zinc-coated steel with primer and baked enamel finish. All components, including accessories shall be contained within the unit.

B. Access to internal components shall be afforded by removable gasketed access panels with quick release latches and lifting handles.

C. Unit shall have factory installed lifting lugs capable of accepting standard lifting slings and spreader bars to facilitate hoisting.

D. Electrical power connections shall be to a single point.

E. Unit shall be insulated with a minimum of 1", 1-pound density glass fiber insulation mat-faced.

F. Unit shall be designed for curb mounting and mate with a full perimeter roof curb for a complete weather tight seal. See Section 23 0300 for roof curb specification. Unit sides shall overhang the curb to form protective drip lip. Supply and return ducts shall connect to the curb prior to placement of the unit. The manufacturer shall furnish gasketing materials for a leak-tight seal between the unit and cut connections.

2.02 HEATING SECTION

A. Provide aluminum or stainless steel slotted port gas burners and aluminized steel heat exchanger. Warranty on heat exchanger shall be 10 years.

B. Controls shall include redundant gas valve and intermittent pilot with electric spark ignition.

2.03 COMPRESSOR

A. Semi-hermetic reciprocating compressor shall be provided with capacity reduction of a minimum of 50% on units 15 tons and larger. Units smaller than 15 tons shall have hermetic compressors.

B. A crankcase heater shall be provided and wired to be active continuously.

C. The compressor shall be provided with spring isolators and flexible discharge line and hot gas muffler.

D. Motor shall be specifically designed for operation within a refrigerant atmosphere. Inlet screens shall be provided. Motor shall be capable of starting and continuously operating at ambients as high as 120 degrees F. Motor shall have overload protection and internal thermostats.

E. Compressor motor shall be capable of withstanding voltage fluctuations of plus or minus 10% of name plated voltage.

2.04 REFRIGERATION CIRCUIT

A. The unit shall be certified as complying with ARI Standard 210 and bear the ARI seal.

B. The evaporator coil shall consist of 3/8" O.D. copper tubes mechanically bonded to aluminum plate fins and be pressure and leak tested at 425 psig. Condenser fans shall be statically and dynamically balanced. Fan motors shall be UL listed for outdoor use, have built-in thermal overload protection and permanently lubricated bearings. Condensing section shall be designed for a maximum of 130 degrees F condensing temperature with ambient air at 95 degrees F. Coil shall be circuited for subcooling.

C. Unit shall incorporate an insulated and sealed drain pan with threaded drain connections at each end of the unit. The Contractor shall install P-traps.

D. Refrigeration controls shall include as a minimum, high and low pressure control, compressor winding thermostat and overload, lockout circuit re-settable at the unit thermostat, contactors for condenser/evaporator fans and compressor, and 24 volt control power transformer.

2.05 EVAPORATOR FANS

A. Evaporator fan shall be direct driven or belt driven forward curved type with an adjustable sheave and motor sized to meet the air flow and static pressure as scheduled on the Drawings.

B. Fans assembly shall be isolated from the unit on RIS isolators.

C. Motor shall have thermal overload protection and motor and fan bearings shall be permanently lubricated.

D. Fan wheel shall be protected from corrosion with a painted finish.

2.06 ACCESSORIES TO BE PROVIDED (see equipment schedules on plans)

PART 3 – EXECUTION

3.01 EQUIPMENT

A. Unit shall be run tested at factory before shipping.

3.02 INSTALLATION

A. Unit shall be installed level within manufacturer’s recommendations.

B. The Contractor shall install a second set of filters at job completion.

END OF SECTION

SECTION 23 7401
CUSTOM VARIABLE REFRIGERANT FLOW ROOFTOP UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Outdoor air handling units with DX condensing units and components as scheduled and shown on drawings.

B. Motor disconnects, motor starters, and variable frequency drives.

1.02 RELATED SECTIONS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, equipment schedules, and drawings apply.

B. The requirements of section 23 81 30 Variable Refrigerant Flow Heat Pump shall be referenced for the outdoor condensing unit requirements.

1.03 REFERENCES

A. AMCA 99 – Standard Handbook

B. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes

C. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters

D. AMCA 611-95 – Methods of Testing Airflow Measurement Stations for Rating

E. ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings

F. ANSI/UL 900 – Test Performance of Air Filter Units

G. AHRI 260 – Sound Rating of Ducted Air Moving and Conditioning Equipment

H. AHRI 410 – Forced-Circulation Air Cooling and Air Heating Coils

I. ANSI/AHRI 430 – Performance Rating of Central-Station Air Handling Units

J. ASHRAE 52.1/52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

K. ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality

L. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

M. ASTM-C 1338 – Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

N. NFPA 70 – National Electric Code (conductors, equipment and raceways)

O. NFPA 90A – Installation of Air Conditioning and Ventilation Systems

P. SMACNA – HVAC Duct Construction Standards

Q. UL-181 – Mold Growth and Humidity Test

R. UL-1995 – Standard for Safety for Heating and Cooling Equipment

1.04 QUALITY ASSURANCE

A. The design indicated on the schedules and shown on the drawings is based upon the products of the named manufacturer. Alternate equipment manufacturers are acceptable if equipment meets scheduled performance requirements and dimensional requirements.

1.05 COORDINATION

A. If equipment is supplied by a manufacturer other than the one named, coordinate with the General Contractor and affected subcontractors to ensure the specified performance is met. This coordination shall include (but is not limited to) the following:
   1. Structural supports for units.
   2. Size and location of concrete bases/housekeeping pads
   3. Location of roof curbs, unit supports and roof penetrations
   4. Ductwork sizes and connection locations
   5. Piping size and connection/header locations
   6. Interference with existing or planned ductwork, piping and wiring
   7. Electrical power requirements and wire/conduit and over current protection sizes.
   8. Trap height requirements

B. The Mechanical Contractor shall be responsible for costs incurred by the General Contractor, Subcontractors, and Consulting Engineers to accommodate units furnished by a manufacturer other than manufacturer named as basis of design.

1.06 RATINGS AND CERTIFICATIONS

A. Unit shall conform to AMCA 210 for fan performance ratings.

B. Unit shall conform to E.T.L. standards. Unit shall be ETL listed.

C. Unit casing radiated sound ratings shall be reported in accordance with ISO 9614 parts 1&2 and ANSI S12.12.

D. Unit shall conform to AHRI 410 for capacities, pressure drops, and selection procedures of air coils.

E. Motors covered by the Federal Energy Policy Act (EPACT) shall meet EPACT requirements.

F. Damper performance shall comply with AMCA 500.

G. Airflow Monitoring Stations shall be rated in accordance with AMCA 611-95 and bear a Certified Ratings Seal for Airflow Measurement Performance.

H. Units shall be ISO 9001 certified.

I. Units shall be manufactured in an ISO 9002 certified facility.

J. Filter media to comply with ANSI/UL 900 listed Class I or Class II.

K. Control Wiring comply with NEC codes & ETL requirements.

L. Units shall comply with energy use AHSRAE 90.1.

1.07 SUBMITTAL DOCUMENTATION REQUIRED

A. Furnish fan performance ratings and fan curves with specified operating point clearly plotted.

B. Furnish drawings indicating unit dimensions, required clearances, field connection locations, wiring diagrams, shipping drawings, and curb drawings.

C. Furnish performance report showing unit level performance data including: fan(s), motor(s), coil(s) and other functional components. Performance report shall also include unit casing performance.

D. Furnish operation and maintenance data, including instructions for lubrication, filter replacement, motor and drive replacement, and condensate pan cleaning; spare parts lists, and wiring diagrams.

E. Adjust and report performance ratings for the proper altitude of operation.

F. Report air-handling unit performance ratings in accordance with ANSI/AHRI-430 (static pressure, airflow, fan speed, and fan brake horsepower).

G. Report static pressure profiles by component section.

H. Report coil ratings in accordance with AHRI-410 (capacities and pressure drops).

I. Report unweighted octave band AHU sound power for inlets and outlets rated in accordance with AHRI Standard 260. Provide eight data points, the first for the octave centered at 63 Hz, and the eighth centered at 8,000 Hz. Manufacturer shall not use sound estimates based on bare fan data (AMCA ratings), nor use calculations like the substitution method based on AHRI 260 tests of other AHU products. Provide data for inlets and outlets as scheduled. Report unweighted casing radiated sound power over the same 8 octave bands in accordance with ISO 9614 Parts 1&2 and ANSI S12.12.

J. Airflow measuring device performance shall be certified and rated in accordance with AMCA-611. Report data in accordance with AMCA-611. Provide AMCA Certified Rating Seal for Airflow Measurement Performance.

K. Report panel deflection at +/-10” w.g., stated in terms of ‘L/X’ where ‘L’ is the casing panel length and ‘X’ is a constant provided by the AHU manufacturer.

L. Report casing leakage rate at +/-10” w.g., specified in terms of percentage of design airflow.

M. Report weight loads and distributions by component section.

N. Report product data for filter media, filter performance data, filter assembly, and filter frames.

O. Report electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

P. Report motor electrical characteristics.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with ASHRAE 62, Section 5 (mold and corrosion resistant casings, filters upstream of wetted surfaces, and drain pan design).

B. Comply with ASHRAE 62, Section 7 (practices to be followed during construction and startup). Protect equipment from moisture by appropriate in-transit and on-site procedures.

C. Follow manufacturer's recommendations for handling, unloading and storage.

D. Protect, pack, and secure loose-shipped items within the air-handling units. Include detailed packing list of loose-shipped items, including illustrations and instructions for application.

E. Protect, pack and secure controls devices, motor control devices and other electronic equipment. Do not store electronic equipment in wet or damp areas even when they are sealed and secured.

F. Enclose and protect control panels, electronic or pneumatic devices, and variable frequency drives. Do not store equipment in wet or damp areas even when they are sealed and secured.

G. Seal openings to protect against damage during shipping, handling and storage.

H. Wrap indoor units with a tight sealing membrane. Wrapping membrane shall cover entire AHU during shipping and storage. Cover equipment, regardless of size or shape. Alternatively AHU must be tarped for shipment and storage.

I. Wrap equipment, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust and corrosion. Keep equipment clean and dry.

J. Clearly mark AHU sections with unit tag number, segment sequence number, and direction of airflow. Securely affix safety-warning labels.

1.09 EXTRA MATERIALS

A. Provide one set of filters for balancing, and one additional set for final turnover to owner.

1.10 WARRANTY

A. Provide warranty for 18 months from date of shipment. Warranty shall cover manufacturer defects. Warranty work shall be performed by manufacturer's factory-trained and factory-employed technician.

B. Include factory-provided controls in the parts warranties.

C. Parts associated with routine maintenance, such as belts and air filters shall be excluded.

1.11 SYSTEM STARTUP

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Comply with manufacturer's start-up requirements to ensure safe and correct operation and integrity of warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule as **YORK Custom, div. of Johnson Controls Inc.** or comparable product by one of the following:
   1. Trane Custom TCFS, div of Ingersoll Rand Inc.
   2. VTS Group
   3. Daikin Custom

B. Acceptable standards shall be supplied based upon the basis of design VRF model specified. At least 10 days prior to the bid date, alternate manufacturers shall request permission to bid, in writing, from the engineer. This request by the contractor to bid an alternate supplier for the basis of design, listed or not listed, shall not relieve the contractor from supplying all materials, options, controls, sequences, efficiencies, and intent of the original specifications written or implied by the VRF model number or model family or as otherwise specified. The written request and engineers' written response to such request shall be included in all submittal documents for approval.

2.02 UNIT DESCRIPTION

A. Variable Refrigerant Flow (VRF) HVAC system shall be a direct expansion (DX) heat Pump system. The outdoor unit shall consist of one or more frames (modules) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to one outdoor unit (York Custom AHU) through a common refrigerant piping network and integrated system controls and communication network. The modules will be factory mounted on a common base/skid with the air handling unit. All piping, insulation and interconnected wiring will be done at the factory. Units will be single point power.

B. The outdoor unit shall be an air cooled condensing unit with vertical discharge that uses refrigerant R-410A. The condensing unit may connect to an evaporator capacity up to 150% of the condensing unit capacity without any special factory approval. All zones are each capable of operating separately with individual temperature control.

C. The condensing unit shall be interconnected to the Custom Air Handling unit in accordance with the AHU engineering manual. The air handling units shall be connected to the condensing unit utilizing specified piping joints and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable for a variable refrigerant system.

2.03 AIR HANDLING UNIT CASINGS

A. Unit Casing Performance
   1. Leakage shall be no more than 1/2% of rated unit CFM at +/- 10” static pressure. Manufacturer shall perform a factory leakage test on at least one unit. Customer shall select which unit to test. Perform test at 10” static pressure. If unit fails at the factory, manufacturer shall seal and retest unit until it meets specified performance.
   2. Deflection shall be no more than L/240 of panel length at +/- 10” static pressure. Manufacturer shall perform a factory deflection test on at least one unit. Customer shall select which unit to test. Measure deflection on the largest wall panel. Perform test at 10” static pressure. If unit fails, manufacturer shall add structural support required to achieve specified performance.
   3. Thermal performance:
      a) R-value of wall shall be R-13 at the center of panel.

B. 2” foam injected thermal break walls. Construct walls with interior and exterior sheet metal surfaces, internal post structure, and 2” of injected foam insulation. Foam board or fiberglass insulation is not acceptable.
   1. Interior Liner:
      a) Galvanized Steel, G90 shall be 22 ga.
   2. Exterior surface
      a) Pre-painted galvanized steel shall be 18 ga
   3. Internal Post Structure: Formed galvanized 16 ga steel C-channel. Post spacing shall be designed to provide L/240 wall deflection at +/- 10” w.g. Maximum post spacing shall be 24” on centers.
   4. Casing Joints: Joints shall be mechanically fastened. Fasteners shall not extend from the outside to the inside of the unit. Use angle to fasten and seal walls at corners, floors, and roofs.
   5. Sealing: Seal joints with polyurethane water resistant sealant.

C. Roofs
   1. Construction of the roof shall be identical to the wall construction specified.
   2. Unit roof for outdoor units are to be sloped a minimum pitch of ¼” per foot.
   3. The roof shall overhang all side and end panels to prevent precipitation drainage from streaming down the unit wall panels. Gutter systems are not acceptable.
   4. Roofs shall be sloped to the non-door side of the unit.
   5. Roof construction shall accommodate a minimum snow-load of 30 lb/ft^2.
   6. Roof shall be designed to hold a 300lb load for service and maintenance.
   7. The roofing system shall consist of a white (or custom color) 100% acrylic elastomeric coating with mildewcide. Coating shall be a minimum 20 mils thick. Coating shall meet the following requirements:
      a) CRRC Solar Index Rating of 112 per ASTM E1980-01
      b) CRRC Initial Solar Reflectance of 0.89; 0.81 after 3 years
      c) CRRC Initial Thermal Emittance of 0.89; 0.87 after 3 years
      d) Fungi Resistance per ASTM G21 of zero growth

8. Outdoor roofs supplied with non-sloped roofs or standing seam roof systems are not acceptable.
9. For all outdoor roof duct connections provide a minimum 1.5” duct flange.

D. Casing Insulation and Adhesive:
1. Materials: ASTM C 1071, Type I
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
   a) Liner Adhesive: Comply with ASTM C 916, Type I.
   b) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c) Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

E. Inspection and Access Panels and Access Doors:
1. Panel and Door Fabrication: Formed and reinforced, double-wall, 2-inch insulated panels of same material type as unit casing.
2. Inspection and Access Panels:
   a) Fasteners: Attached to unit casing with tek screws with EPDM washers on maximum 9-inch centers.
   b) Gasket: 3/4” wide x 1/8” thick PVC gasket applied around entire perimeters of panel frames and the access openings.
   c) Construction: Factory shall provide double sided tape where liner is attached to internal supports.
3. Access Doors:
   a) Frames: Type 6063-T5 aluminum extrusion, with thermal break for "no through metal" construction, sealed at the corners and attached to the unit casing with plated hardware**.**
   b) Hinges: Stainless steel piano hinge with minimum two roller cam latches per door, operable from inside and outside.
   c) Handles: Glass fiber reinforced, UV rated, pad-lockable, nylon polyamide as manufactured by Allegis Corporation.
   d) Gasket: Closed-cell EPDM, applied around entire perimeters of panel frames.
   e) Viewports: Provide 8”x8” tempered glass viewing window centered horizontally in each access door.
   f) Test Ports: Ventlok No. 699 instrument test holes installed in door locations as required to measure pressure drops across unit.
   g) Rain Lip: Provide rain lip of same material type as unit casing attached with tek screws above all access doors.
   h) Interlock Switch: Provide NEMA 3R, plunger type interlock switch mounted on doors as noted on submittal drawing.

F. Floors:

1. Floor shall be 0.125-in aluminum diamond plate stitch welded, caulked and sealed to the base.

Floor shall be insulated with 4-inch polyurethane spray foam insulation.

2. Floor shall be thermally isolated from welded base frame members (perimeter and internal supports). Construction without thermally isolated floor and walls shall not be acceptable.
3. Subfloors:
   a) Subfloor shall be 22 ga. G90 Galvanized Steel screwed to the base channel.

G. Baserails:
   1. Type ASTM A36 welded structural steel c-channel, 6-inch height, with cross supports spaced at regular intervals and removable lifting lugs. Factory shall provide curb angle welded to the base for outdoor curb mounted units.

2.04 FAN ARRAYS

A. Fan Arrays: Fan arrays shall consist of multiple direct-drive, 2x1, modular plenum fans selected to provide the scheduled airflow at the scheduled total static pressure. Fans shall be statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower. Fans shall have a sharply rising pressure characteristic extending through the operating range and continuing to rise beyond the peak efficiency to ensure quiet and stable operation. Fans shall have a non-overloading design with self-limiting horsepower characteristics and shall reach a peak in the normal selection area. All fans shall be capable of operating over the minimum pressure class limits as specified in AMCA's Standard 2408-69.

B. Fans shall be tested in accordance with AMCA 210 and AMCA 300 test standards for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for fan inlet sound, fan outlet sound, and air performance.

C. Fan Housings: Steel frame and panel; fabricated without fan scroll. Shall incorporate a non-overloading type backward inclined airfoil blade wheel. Flat plate blades shall not be acceptable Fans shall be provided with heavy-gauge reinforced steel inlet plate and structural steel frame.

D. Internal Vibration Isolation and Seismic Control:
   1. Fans shall be factory mounted with Neoprene pads.
   2. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounting frame and air-handling-unit mounting frame are anchored to building structure.

2.05 MOTORS

A. All fan motors shall comply with NEMA and IEEE for temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Enclosure Type shall be totally enclosed, fan cooled (TEFC).
   2. All fan motors shall be NEMA Premium™ efficient motors as defined in NEMA MG 1.

3. Motors shall be rated for continuous duty at full load at 40°C ambient temperature rise.
4. Motor sizes shall be as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.15.
5. Motors shall be 3600rpm at 60Hz
6. Motors shall have an insulation Class F.
7. Motors shall include a shaft grounding ring.

2.06 COILS

A. General Requirements for Coil Section:
1. Provide coils manufactured by AHU manufacturer, except where noted in contract documents.
2. Coils shall meet or exceed performance scheduled on drawings.
3. Locate access doors near coils connections to provide minimum clearance of 2 inches for field installed external piping insulation. Space shall allow a minimum of 90 degrees of door swing.
4. Provide coil segment casing that meets or exceeds casing thermal performance of the unit. Provide coil pull panel that are easily removable with no special tools. Coils shall be removable from the side of the AHU. For units with multiple stacked coils, provide a stacking rack to allow individual coils to be removed from side of AHU without disturbing any other coils.
5. Provide an intermediate drain pan on stacked cooling coils or any cooling coil taller than 48 inches finned height. Intermediate drain pan shall slope in a minimum of two planes and provide copper downspouts to lower drain pan.
6. Direct expansion (DX) coils shall conform to UL-207, “Standard for Safety: Refrigerant – Containing Components and Accessories, Nonelectrical,” when operating with a maximum refrigerant pressure of 325 psig. Factory shall test DX coils with 325 psig compressed air under water. DX coils shall be dehydrated and sealed prior to installation.
7. Provide DX coils with brass distributor and solder-type connections. Suction and discharge connections shall be on the same end regardless of coil depth.
8. Provide submittals with Cross plot table and chart with selected DX coil and Condensing unit provided.
9. Provide DX coils with a tube OD of 5/8 inch. Mechanically expand tubes to form fin bond and provide burnished, work-hardened interior surface.
10. Return bends shall be hairpin construction on 5/8” .020’ twt**.** All other tube wall thicknesses will be brazed return bends.
11. Provide coils with die-formed, continuous Aluminum fins. Fins shall have fully drawn collars to accurately space fins and protect tubes. Sine wave, Fin thickness shall be .008 inches.

2.07 AIR FILTRATION

A. General Requirements for Air Filtration Section:
1. Filters shall be manufactured by Koch, Camfil/Farr, or Flanders.
2. Provide a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter segments with filters and frames as scheduled.

4. Provide filter holding frames arranged for flat or angular orientation, with access doors as indicated on drawings. Filters shall be removable from one side or lifted out from access plenum.
5. Filter media shall be in compliance with UL900.

B. Filters:
1. Pre-Filter: 2” Pleated MERV 8
2. Final Filter: 4” Minipleat MERV 14
3. High Efficiency Galvanized Filter Frame
4. Combined Filter Gauge

2.08 DAMPERS

A. Control Dampers: Dampers shall be parallel-blade, leakage Class 1A design with a leakage rate that shall not exceed 3 cfm/sq. ft. (15 L/s· m^2) at 1 in. w.g. (249.09 Pa) pressure differential when tested according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating." Dampers shall be provided with galvanized-steel airfoil- shaped, single-piece blades with flexible metal compressible type jamb seals, extruded Ruskiprene blade edge seals, and stainless-steel sleeve bearings mounted in a single galvanized-steel frame. Axles shall be hexagonal positively locked into the damper blade. Dampers shall be provided with a jackshaft.

2.09 TESTING

A. Factory Panel Deflection Test: The unit manufacturer shall provide a factory deflection test on one unit. Casing panel deflection shall not exceed L/240 at +/- 10” w.g. (or as required by AHRI 1350.) ‘L” is defined as the panel span length and ‘L/X’ is the deflection at panel midpoint. Measurements shall be taken along the vertical seam of the largest panel on the side.

B. Factory Leak Testing: The unit manufacturer shall provide a factory leak test on one unit across the cabinet exterior walls. Casing leakage shall not exceed 0.5% of design CFM at +/-10” w.g. (or as required by AHRI 1350.)

C. Should a unit fail a test, the unit shall be treated with a permanent remedy at manufacturer’s expense until test is successfully passed.

2.10 LIGHTS AND OUTLETS

A. Lights
1. Vapor Resistant Pendant: Factory shall provide vapor resistant pendant, marine type light fixture with clear globe, metal guard, and 100W incandescent bulb in segments and quantity as noted on drawings.
2. Factory shall wire all light fixtures to a common 120v switch located on the supply fan segment.
3. Factory shall wire each light fixture to a separate 120v switch located near the access door of the segment with the light fixture.

A. Outlets
1. Factory shall provide a 15A GFI duplex outlet mounted in a weatherproof enclosure in segments and quantity as indicated on the drawings.

2.11 HOODS AND LOUVERS

A. Louvers
   1. Provide 16 ga., galvanized steel, stationary type, drainable blade louver with downspouts in the jamb and mullions and 1/4" sq. galvanized mesh birdscreen. Blades shall be housed inside a 16 ga. galvanized steel frame flush mounted to the unit exterior. Louver to be pre-painted with baked enamel finish in manufacturer's standard Champagne.

B. Weather Hood
   1. Provide weather hood of same material type and thickness as unit exterior skin with 1/4" sq. galvanized mesh birdscreen.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment per industry standards, applicable codes, and manufacturer's instructions.

B. RTUs shall not be used for temporary heating, cooling or ventilation prior to complete inspection and startup performed per this specification.

C. Install RTUs on a concrete pad, roof curb, or structural steel base, as shown on drawings.

D. Install RTUs with manufacturer's recommended clearances for access, coil pull, and fan removal.

E. One complete set of filters shall be provided for testing, balancing, and commissioning. Provide second complete set of filters at time of transfer to owner.

F. Install RTU plumb and level. Connect piping and ductwork according to manufacturer's instructions.

G. Install seismic restraints and anchors per applicable local building codes. Refer to specification Section 230548 (15240 / 15070) for product and installation requirements.

H. Insulate plumbing associated with drain pan drains and connections.

I. Install insulation on all staggered coil piping connections, both internal and external to the unit.

3.02 FIELD QUALITY CONTROL

A. RTU shall be stored as per manufacturer's written recommendations.

B. RTUs shall be stored indoors in a warm, clean, dry place where unit(s) will be protected from weather, construction traffic, dirt, dust, water and moisture. If unit(s) to be stored for more than 6 months, manufacturer's instruction for long-term storage shall be followed.

C. Rig and lift units shall be according manufacturer's instructions.

3.03 AHU INSPECTION

A. Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:
   1. Damage of any kind
   2. Level installation of unit
   3. Proper reassembly and sealing of unit segments at shipping splits.
   4. Tight seal around perimeter of unit at the roof curb
   5. Installation of shipped-loose parts, including filters, air hoods, bird screens and mist eliminators.
   6. Completion and tightness of electrical, ductwork and piping
   7. Tight seals around wiring, conduit and piping penetrations through AHU casing.
   8. Supply of electricity from the building's permanent source
   9. Integrity of condensate trap for positive or negative pressure operation
   10. Condensate traps charged with water
   11. Removal of shipping bolts and shipping restraints
   12. Sealing of pipe chase floor(s) at penetration locations.
   13. Tightness and full motion range of damper linkages (operate manually)
   14. Complete installation of control system including end devices and wiring
   15. Cleanliness of AHU interior and connecting ductwork
   16. Proper service and access clearances
   17. Proper installation of filters
   18. Filter gauge set to zero

B. Resolve any non-compliant items prior to unit start-up.

3.04 INSPECTION AND ADJUSTMENT: AHU FAN ASSEMBLY

A. Hire the manufacturer's factory-trained and factory-employed service technician perform an inspection of the AHU fan assembly subsequent to general AHU inspection and prior to startup. Technician shall inspect and verify the following as a minimum:
   1. Fan isolation base and thrust restraint alignment
   2. Tight set screws on pulleys, bearings and fan
   3. Tight fan bearing bolts
   4. Tight fan and motor sheaves
   5. Tight motor base and mounting bolts
   6. Blower wheel tight and aligned to fan shaft
   7. Sheave alignment and belt tension
   8. Fan discharge alignment with discharge opening
   9. Fan bearing lubrication
   10. Free rotation of moving components rotate manually

B. Manufacturer shall dynamically balance fan/motor/base assembly.
   1. Balance constant volume fan assemblies at design RPM.
   2. Balance variable volume fan assemblies from 10% to 100% of design RPM.
   3. Take filter-in measurements in the horizontal and vertical axes on the drive and opposite-drive sides of fan shafts.
   4. Constant speed fan vibration limits: filter-in measurements shall not exceed 4 mils.

5. Variable speed fan vibration limits: filter -in measurements shall not exceed 7 mils.

C. Manufacturer shall hi-pot test wiring intended to carry voltages greater than 30VAC.

3.05 STARTUP SERVICE and OWNER TRAINING

A. Manufacturer's factory-trained and factory-employed service technician shall startup AHUs. Technician shall perform the following steps as a minimum:
   1. Energize the unit disconnect switch
   2. Verify correct voltage, phases and cycles
   3. Energize fan motor briefly ("bump") and verify correct direction of rotation.
   4. Re-check damper operation; verify that unit cannot and will not operate with all dampers in the closed position.
   5. Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.

B. Provide a minimum of 4 hours of training for owner's personnel by manufacturer's factory-trained and factory-employed service technician. Training shall include AHU controls, motor starter, VFD, and AHU.

C. Training shall include startup and shutdown procedures as well as regular operation and maintenance requirements.

D. If AHU is provided with a factory-mounted variable frequency drive (VFD), hire the VFD manufacturer's factory-trained and factory-employed service technician to inspect, test, adjust, program and start the VFD. Ensure that critical resonant frequencies are programmed as 'skip frequencies' in the VFD controller.

E. Submit a startup report summarizing any problems found and remedies performed.

3.06 FIELD PERFORMANCE VERIFICATION

A. Leakage: Pressurize casing to maximum operating static pressure (up to +/-8" w.g.) and measure leakage. If leakage exceeds 1% of design airflow, seal leakage points with a permanent solution. Repeat test. If the AHU still does not pass, contact the manufacturer to seal unit.

B. Submit a field test report with testing data recorded. Include description of corrective actions taken.

3.07 CLEANING

A. Clean unit interior prior to operating. Remove tools, debris, dust and dirt.

B. Clean exterior prior to transfer to owner.

3.08 DOCUMENTATION

A. Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.

B. Provide six copies of Spare Parts Manual for owner's project system manual.

END OF SECTION

SECTION 23 7402
SINGLE PACKAGE ROOFTOP HEAT PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 00 00 - HVAC General.

B. Furnish and install factory assembled, piped and wired single package rooftop heat pumps of the type, operational characteristics and capacity as shown and scheduled and as specified herein. All rooftop units shall be by the same manufacturer. The manufacturer shall have available factory trained service engineers and an inventory of replacement parts within a 100-mile radius of the job site.

C. Refer to the drawings for basis of design manufacturer and acceptable alternates.

D. Compressor shall be warranted against parts failure for five (5) years.

E. Submit catalog cuts, certified performance data, and dimensional data.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Unit shall be designed specifically for outdoor installation with all exterior surfaces of phosphatized, zinc-coated steel with primer and baked enamel finish. All components, including accessories shall be contained within the unit.

B. Access to internal components shall be afforded by removable gasketed access panels with quick release latches and lifting handles.

C. Unit shall have factory installed lifting lugs capable of accepting standard lifting slings and spreader bars to facilitate hoisting.

D. Electrical power connections shall be to a single point.

E. Unit shall be insulated with a minimum of ½" thick, 1½ lb./ft^3 density fiberglass insulation. Insulation shall have a microbial resistant neoprene coating.

F. Unit shall be designed for curb mounting and mate with a full perimeter roof curb for a complete weather tight seal. Curb shall be a minimum of 24" high and manufactured of 12-gauge zinc-coated steel and be supplied by the unit manufacturer with wood nailer strip and full perimeter gasket. Unit sides shall overhang the curb to form protective drip lip. Supply and return ducts shall connect to the curb prior to placement of the unit. The manufacturer shall furnish gasketing material for a leak-tight seal between the unit and duct connections.

2.02 HEATING SECTION

A. If scheduled, provide an open wire electric heating coil with thermal high limit cut-outs and over current protection. Units with electric heat shall have a single point power connection.

2.03 COMPRESSOR

A. Fully hermetic scroll or rotary compressor(s) shall be provided with capacity reduction of a minimum of 50% on units 7½ tons and larger.

B. A crankcase heater shall be provided and wired to be active continuously.

C. The compressor shall be provided with spring isolators and flexible discharge line and hot gas muffler.

D. Motor shall be specifically designed for operation within a refrigeration atmosphere. Inlet screens shall be provided. Motor shall be capable of starting and continuously operating at ambient temperatures as high as 120ºF. Motor shall have overload protection and internal thermostats.

E. Compressor motor shall be capable of withstanding voltage fluctuations of plus or minus 10% of name plate voltage.

2.04 REFRIGERANT CIRCUIT

A. The unit shall be certified as complying with AHRI Standard 210/240 or 340/360 and bear the AHRI seal.

B. The indoor coil shall be constructed of 3/8" O.D. copper tubes mechanically bonded to aluminum plate fins and be pressure and leak tested at 425 psig. Outdoor fans shall be statically and dynamically balanced. Fan motors shall be UL Listed for outdoor use, have built-in thermal overload protection and permanently lubricated bearings. Condensing section shall be designed for a maximum of 130ºF condensing temperature with ambient air at 95ºF. Coil shall be circuited for sub-cooling.

C. Unit shall incorporate an insulated and sealed IAQ drain pan with threaded drain connections at each end of the unit. The Contractor shall install P-traps. Overflow protection shall be provided via a float switch wired to shut the unit off if liquid is detected.

A. Refrigeration controls shall include as a minimum, high and low pressure control, compressor winding thermostat and overload, lockout circuit re-settable at the unit thermostat, contactors for condenser/evaporator fans and compressor, 24 volt control power transformer, reversing valve, defrost cycle and emergency heat.

B. Unit shall ship with an operating charge of R-410A.

2.05 INDOOR FANS

A. Indoor fans shall be direct driven or belt driven forward curved type with an adjustable sheave and motor sized to meet the air flow and static pressure as scheduled.

B. Fan assembly shall be isolated from the unit on rubber-in-shear or spring type isolators.

C. Motor shall have thermal overload protection and motor and fan bearings shall be permanently lubricated.

D. Fan wheel shall be protected from corrosion with a painted finish.

2.06 FILTERS

A. Two (2) sets of 2" low velocity filters shall be provided with the unit. Filters shall be MERV 8, pleated, disposable type equal to Farr 30/30 or as scheduled.

B. Only one size filter per unit is allowed.

C. During construction, the initial set of filters will be installed along with temporary media consisting of two plys of polyester fibers; 1¼" (32mm) thick with a non-migrating tackified surface having a MERV 8 rating.

1. For non-ducted (plenum return) systems, use roll filter media over each inlet duct.
2. For ducted systems, use precut pads with holding frames installed at each return air register or grille.

2.07 ACCESSORIES TO BE PROVIDED

A. Accessories noted below may not be required for equipment scheduled. Refer to the equipment schedules on the drawings for specific accessory requirements.

B. 7-day programmable thermostat with clear plastic locking cover.

C. Thermostat sub-base with fan ON-AUTO and HEAT-OFF-COOL control.

D. Programmable/Lockable Averaging Thermostat/Humidistat with Interlocked Temperature/Humidity Sensor.

E. Non-fused disconnect switch.

F. Low leakage dampers.

G. Outside air intake hood with inlet screen.

H. Manual outside air volume damper.

I. Propeller fan exhaust and low leakage damper.

J. Anti-cycling timer to provide 5-minute delay between compressor shut-down and restart.

K. Head pressure controls to allow compressor operation to -20°F.

L. Roof curb. Coordinate with the roof system used so that a minimum of 8" of the curb is above the finished roof for flashing purposes. The top of the curb shall be level and the slope of the roof shall be compensated for by the curb.

M. Dry bulb controlled economizer cycle with minimum position rheostat including dampers with modulating controllers and spring return operators.

N. Enthalpy controlled economizer cycle with minimum position rheostat including dampers with modulating controllers and spring return operators.

O. Demand controlled ventilation - A CO_2 sensor shall also be provided loose for wall mounting. The CO_2 sensor shall be wired to the rooftop unit economizer such that on a CO_2 level rise the outside air damper shall modulate until the CO_2 level returns below setpoint which shall return the outside air damper back to normal operation. The CO_2 sensor manufacturer shall be the same as the rooftop unit manufacturer.

P. Remote control panel with fan and system controls, and indicating lights for system operation, dirty filter and emergency heat.

Q. Seismic restraint brackets conforming to ASCE 7-10, Chapter 13.

R. DDC system communicating controller.

S. Hail Guards.

T. Phase Monitor (3 phase units only)

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Unit shall be shipped with a full refrigerant charge.

B. Unit shall be run tested at factory before shipping.

3.02 INSTALLATION

A. Unit to be installed level with manufacturer's recommendations.

B. The second set of filters shall be installed after testing and balancing has been completed.

END OF SECTION

SECTION 23 8123.14
COMPUTER ROOM AIR CONDITIONING (CRAC) UNITS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Unit shall be a water-cooled DX system utilizing a remote drycooler. Indoor unit shall include a DX refrigerant circuit with an airside evaporator, a water-cooled condenser section, and water side economizer coil. Hydronic system shall be water/glycol as required to prevent freezing of the water loop.

B. Furnish and install Computer Room Air Conditioning (CRAC) Units of the size and capacity shown on the equipment schedules. Provide a full and complete system with all necessary components, pipes, piping trim, and accessories to meet the design intent including any field supplied components/accessories required to comply with the manufacturer's installation and operation guidelines.

C. The requirements of the General Conditions, Supplementary Conditions, and Section 23 00 00 - HVAC General apply to all work specified in this section.

D. Equipment components shall be matched for compatibility and shall be rated in accordance with ASHRAE 127 test procedure.

E. Equipment schedules and specifications are based on particular manufacturers. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract that may be required to satisfy plans and specifications. Acceptable manufacturers shall be Liebert (Vertiv), Stulz, Data Aire, or APC.

1.02 SUBMITTALS

A. Submittal documents shall be prepared by the manufacturer for the specific conditions, components, and capacities as shown on the contract drawings and these specifications.

B. Submittal package shall include the following:
1. Operating conditions
2. Equipment capacities and flow rates
3. Compressor data
4. Pumps (dual pump package)
5. Dry cooler
6. Expansion tank
7. Controls

1.03 QUALITY ASSURANCE

A. Units shall be tested and certified in accordance with ASHRAE Standard 127 Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners.

PART 2 - PRODUCTS

2.01 INDOOR UNITS

A. Upflow air supply, bottom front return. The return air shall enter the unit from the front of the unit through factory installed grilles. Cabinet shall allow maintenance access to all components from the front of the unit.

B. Provide 4” pleated filters, MERV 8 rating minimum or as called out in the schedule, whichever is higher.

C. Evaporator fan shall be the ECM type at the scheduled CFM and external static pressure.

D. Humidifier shall be factory installed within the unit. The humidifier shall be of the infrared type, consisting of high intensity quartz lamps mounted above and out of the water supply. Humidifier pan shall be stainless steel and be removable without disconnecting high voltage electrical connections. The humidifier shall be equipped with an automatic water supply system and shall have an adjustable water overfeed to prevent mineral precipitation. A high-water detector shall shut down the humidifier to prevent overflowing. An air gap shall prevent back siphonage of the humidifier water supply.

E. Each unit shall include (2) independent refrigeration circuits. Compressors shall be scroll type with variable capacity operation capability. Provide vibration isolators, thermal overloads, automatic reset high pressure switch. Refrigeration circuits shall contain suction line strainers, filter driers, and refrigerant sight glass with moisture indicator. The circuits shall include a factory installed reheat to control temperature during dehumidification.

F. The system shall be able to function either as a modulating chilled water system or as a compressorized system, or a combination of both. Provide a fully proportional 3-way modulating control valve.

G. Provide an electric reheat coil for use during dehumidification mode. Coils shall be low watt-density 304/304 stainless steel fin tubular construction protected by thermal safety switches. Provide multi-stage control.

H. Provide a leak detection sensor.

I. See schedule on the Drawings for additional accessories.

2.02 DRYCOOLER

A. The drycooler shall be an air-cooled unit designed to reject heat to outdoor air and to control glycol temperature.

B. The drycooler shall be a factory assembled unit consisting of housing, heat exchanger coils, direct-drive propeller fans, electrical controls, and mounting legs.

C. The heat exchanger coils shall be constructed of copper tubes expanded into aluminum fins, with heavy wall type “L” headers.

D. Fans shall have aluminum blades secured to a corrosion protected steel hub. Fans shall be factory balanced. Fan guards shall be heavy gauge close-mesh steel wire with corrosion resistance rated to pass a 1000-hour salt spray test. Fans motors shall be direct drive and provided with a rain shield and permanently sealed bearings. Motors shall be rigidly mounted on die-formed galvanized steel supports.

E. The drycooler shall sense the leaving glycol temperature and cycle fixed-speed fans to maintain glycol temperatures. Aquastats shall have field adjustable setpoints. Each fan

motor shall have individual internal overload protection. The drycooler shall control operation of glycol pumps powered from the drycooler.

F. Electrical controls, overload protection devices, and service connection terminals shall be provided and factory wired inside the integral electrical panel section of the housing. A locking disconnect switch shall be factory mounted and wired. The outdoor components (drycooler and pumps) shall have single point power connection.

2.03 PUMP PACKAGE

A. Provide dual pump option. Pump controls for the dual glycol pump system shall operate one pump as primary and the second pump shall operate as a standby pump.

B. The dual pump package shall include pumps, enclosure, and field-mounted flow switch. The standby pump shall automatically start up on failure of the lead pump.

2.04 ADDITIONAL ITEMS

A. An expansion tank shall be provided as well as air vents. The expansion tank and air vents shall be field installed at the system's highest elevation to allow venting of trapped air.

B. The system shall also include air separator, fluid pressure relief valve, pressure gauges, flow switches, and tempering valves.

C. Provide supply and return piping in accordance with spec section 23 2113 Piping and Accessories. Supply and return piping shall be sized per manufacturer's instructions based on gpm, pressure, and piping length.

D. Field provide a means for adding pre-mixed glycol to system.

PART 3 - EXECUTION

3.01 GENERAL

A. Protect units from physical damage as well as dust and debris. Provide protective crating and covering during transportation, installation, and storage. Units shall not be run during construction other than is necessary for installation, testing, and startup. CRAC units shall be turned over to the Owner at project completion in clean, brand-new condition.

B. Units shall be installed as shown on the drawings and in strict accordance with manufacturer's recommendations. Installation shall be approved by a manufacturer's representative prior to start-up.

C. Units shall be installed level.

D. Units shall be installed to allow adequate service to all components.

E. Coordinate delivery of units in enough time to allow movement into the building.

END OF SECTION

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SECTION 23 8126
SPLIT SYSTEM AIR CONDITIONING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install direct expansion air cooled split system units of the size and capacity shown on the equipment schedules.

B. Units shall be factory matched with air handling units for compatibility and shall be rated in accordance with ARI standards.

PART 2 – PRODUCTS

2.01 OUTDOOR UNIT

A. Outdoor units shall be complete, including cabinet, hermetic compressor, nonferrous condenser coil with guard, condenser fan and motor, refrigerant reservoir or receiver, charging valve, controls, refrigerant holding charge, heavy duty permanently lubricated motors with built-in thermal overload protection, locked rotor, over and under voltage protection, high pressure cutout with auto-reset, motor starters and contactors, compressor protection, crankcase heater, transformer, filter/drier, vibration isolation, and other required components. Casings shall be constructed of zinc-coated steel, double phosphatized and finished with baked enamel for positive weatherproof protection. Removable panels shall provide access to all components from one side of the unit. Drain holes shall be provided in the base for positive drainage. Compressor shall be capable of operation down to 10 degrees F ambient and shall have a 5-year warranty.

2.02 INDOOR UNIT

A. Air handling evaporator unit shall be complete, including cabinet, nonferrous DX cooling coil, centrifugal fans, drives, permanently lubricated motors with thermal overload protection, 1" thick disposable filter(s), expansion valves, solenoid valves, refrigerant charge, insulated galvanized drain pan and other required components. Casings shall be constructed of heavy gauge steel, zinc coated to prevent corrosion and be painted with baked enamel and internally insulated with glass fiber material.

PART 3 – EXECUTION

3.01 GENERAL

A. Units shall be installed as shown on the Drawings and in strict accordance with manufacturer’s recommendations.

B. For roof mounting, provide equipment supports, (minimum two) for each condensing unit with integral flashing cant. Equipment rail as manufactured by Roof Products and Systems Corp. or equal by Pate or Thycurb. Secure condensing unit to equipment support.

C. For grade mounting, provide 4" thick concrete pad 6" larger all around than the condensing unit.

D. Condensing units shall be installed level.

E. Units shall be installed to allow adequate service to all components.

END OF SECTION

SECTION 23 8128
DUCTLESS SPLIT-SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install direct expansion air cooled split system units of the size and capacity shown on the equipment schedules.

B. Units shall be factory matched with air handling units for compatibility and shall be rated in accordance with ARI standards.

C. Equipment schedules and specifications are based on Mitsubishi series units. Other manufacturers of equal quality and capacity may be submitted to the Engineer for approval. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract that may be required to satisfy plans and specifications.

D. Equal products: Sanyo, Daiken, and L.G.

1.02 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period five (5) year from date of installation. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

PART 2 – PRODUCTS

2.01 OUTDOOR UNIT

A. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.

B. The outdoor unit shall be capable of cooling operation down to 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required).

C. The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

D. System shall operate at up to a maximum refrigerant tubing length of 100 feet (30 meters) for the 12,000 and 18,000 and 165 feet (50 meters) for the 24,000, 30,000, 36,000, and 42,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.

E. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

F. Cabinet: The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability. Easy access shall be afforded to all serviceable parts by means of removable panel sections. The fan grill shall be of ABS plastic. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane prone areas.

G. Fan: Units shall have DC fan motor(s). The fan blades shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

H. Coil: The condenser coil shall be of copper tubing with flat aluminum fins. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be controlled by a microprocessor controlled step motor. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a - Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

I. Compressor: Compressor shall be variable speed with inverter drive technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

J. Electrical: The electrical power of the unit shall be 208 volts or 230 volts, single phase, 60 hertz. Power for the indoor unit shall be supplied from the outdoor unit. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

K. Operating Range:

Operating Range		Indoor Air Intake Temperature	Outdoor Air Intake Temperature
Cooling	Maximum	D.B. 95°F (35°C) W.B. 71°F (21.7°C)	D.B. 115°F (46°C)
	Minimum	D.B. 67°F (19.4°C) W.B. 57°F (13.9°C)	D.B. 0°F (-18°C)*
Heating	Maximum	D.B. 80°F (26.7°C) W.B. 67°F (19.4°C)	D.B. 70°F (21.1°C) W.B. 59°F (15°C)
	Minimum	D.B. 70°F (21.1°C) W.B. 60°F (15.6°C)	D.B. 12°F (-11.1°C) W.B. 10°F (-22.2°C)

* Requires wind baffle – without wind baffle: D.B. 23°F (-5°C)

2.02 INDOOR UNIT - WALL MOUNTED TYPE

A. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit, in conjunction with the wired wall-mounted, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.

B. Unit Cabinet: The cabinet shall be formed from high strength molded plastic with smooth finish, flat front panel design with access for filter. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.

C. Fan: The indoor unit fan shall be high performance, double inlet, forward curve, direct drive sirocco fan with a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds: Low, Mid, and Hi and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

D. Vane: There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution.

E. Filter: Return air shall be filtered by means of an easily removable washable filter.

F. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. A condensate pump with check valve and condensate safety switch shall be provided.

G. Electrical: The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The power to the indoor unit shall be supplied from the outdoor unit.

H. System Control: The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit.

I. A wired remote controller shall be provided. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time Buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor.

2.03 INDOOR UNIT - CEILING RECESSED CASSETTE TYPE

A. The indoor unit shall be a space-saving ceiling-recessed cassette type, factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, drain lift mechanism, control circuit board, fan, and fan motor. The unit, in conjunction with the remote controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.

B. Unit Cabinet: The cabinet shall be formed from galvanized sheet metal coated with high-density foam insulation. Cabinet shall be for recessed mounting and provided with four (4) corner mounting supports behind removable corner pockets in Grille assembly allowing adjustment of mounting height from front of unit.

1. There shall be an optional multi-function casement which will mount between the unit cabinet and the Grille assembly to provide a second field installed filtered outside air intake and provide a mount for a high-efficiency filter element.
2. A separate grill assembly shall be attached to the front of the cabinet to provide supply air vanes in four directions and a center mounted return air section. The four-way grill shall be fixed to bottom of cabinet allowing two, three or four-way blow.

C. Fan: The indoor fan shall be an assembly with a turbo fan propeller, direct driven by a single motor and shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speed settings, Low, Mid1, Mid2, High and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

D. Vane: The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow with switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.

E. Filter: Return air shall be filtered by means of an easily removable, long life, washable filter.

F. Coil: The indoor unit shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. The heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan with drain connections shall be provided under the coil. The unit shall also include a built-in, automatic condensate lift mechanism that will be able to raise drain water 33 inches (84 cm) above the condensate pan. The lift mechanism shall be equipped with a positive acting liquid level sensor to shut down the indoor unit if liquid level in the drain pan reached maximum level. An optional secondary drain pan level switch (DPLS1), designed to connect to the control board, shall also be provided if required, and installed on the condensate pan.

G. Electrical: The electrical power of the unit shall be 208/230 volts, 1-phase, 60 hertz. The indoor unit shall be powered and controlled directly from the outdoor.

H. A wired remote controller shall be provided. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor.

PART 3 – EXECUTION

3.01 GENERAL

A. Units shall be installed as shown on the Drawings and in strict accordance with manufacturer's recommendations.

B. For roof mounting, provide equipment supports, (minimum two) for each condensing unit with integral flashing cant. Equipment rail as manufactured by Roof Products and Systems Corp. or equal by Pate or Thycurb. Secure heat pump unit to equipment support.

C. Heat pump units shall be installed level.

D. Units shall be installed to allow adequate service to all components.

END OF SECTION

SECTION 23 8129
VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work specified in this section is subject to the provisions of Section 23 00 00 - HVAC General.

B. This specification stipulates the requirements for the design, fabrication, and performance of air-cooled Variable Refrigerant Flow HVAC Systems.

C. Furnish and install factory assembled components of the Variable Refrigerant Flow HVAC System(s) of the type and operational characteristics shown and as specified herein. All systems and controls shall be by the same manufacturer.

D. Equipment schedules and specifications are intended to establish a minimum level of quality and workmanship for the project. When other than the basis of design equipment is proposed, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

E. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or certified manufacturer's agent. Refer to Section 1.02 Quality Assurance, Section 1.09 Bid Proposals, and Section 1.10 Submittals for requirements.

F. Commissioning shall be performed by the manufacturer or certified manufacturer's agent. The test and balance agency and commissioning agent shall be engaged for all aspects of the commissioning process.

G. The Variable Refrigerant Flow HVAC Systems shall be provided to meet the minimum capacities scheduled at the indicated design conditions, shall meet all constraints of construction and shall comply with all specification sections.

H. System descriptions of Variable Refrigerant Flow (VRF) and Variable Refrigerant Volume (VRV) may be used interchangeably and refer to the same type of system.

I. System component descriptions of Branch Selector (BS); Mode Control Unit (MCU), Heat Recovery Unit (HRU) and Branch Controller (BC/MCU) may be used interchangeably within this specification except within the controls sections below.

1.02 RELATED DOCUMENTS

A. For piping, valves, accessories and piping insulation refer to Section 23 23 00 – Refrigerant Piping.

1.03 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

B. All wiring shall be in accordance with the National Electrical Code (NEC).

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (NEC), Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for their intended use.

D. Fabricate and label refrigeration system to comply with ASHRAE 15 - Safety Standard for Refrigeration Systems. See Submittal paragraph below for Refrigerant Concentration Limit calculations.

E. Energy Efficiency Ratio (EER) and/or Seasonal Energy Efficiency Ratio (SEER): Equal to or greater than prescribed by ASHRAE/IESNA 90.1- Energy Standard for Buildings Except Low-Rise Residential Buildings.

F. Coefficient of Performance (COP) and/or Heating Seasonal Performance Factor (HSPF): Equal to or greater than prescribed by ASHRAE/IESNA 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

G. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001 which is a set of standards applying to environmental protection set by the International Organization for Standardization (ISO). The system(s) shall be factory tested for safety and function.

H. System(s) shall be rated and certified in accordance with AHRI Standard 1230 and meet minimum efficiencies scheduled.

I. Manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.

J. Manufacturer shall have parts, equipment and materials stocked within the U.S. for immediate order.

K. Manufacturer shall have factory certified service technicians available and within 50 miles of the project site.

L. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

1. On-site installation personnel shall be trained and certified by a manufacturer's authorized representative. The installing contractor and installation personnel shall be experienced and have completed a minimum of five (5) previous projects similar in nature, size, and scope of this project. Submit training certificates and a project experience list with system description and contact information for the owner/operator. The mechanical contractor's installation price shall be based on the system's installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements.

M. The condensing unit(s) shall be factory charged with R-410A.

N. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.

1.04 ACCEPTABLE MANUFACTURERS

A. Refer to the drawings for basis of design manufacturer. Alternate manufacturers may be considered for approval so long as the equipment meets or exceeds all the requirements of these Contract Documents.

B. The alternate equipment manufacturer shall provide, to the bidding mechanical contractor, a complete equipment data package seven (7) days prior to bid date. The package shall include, but not be limited to, equipment capacities at standard AHRI and design conditions, power requirements including MCA, RLA, MSC and MOP of each device, indoor units CFM/static pressures, fan curves, installation requirements, refrigerant type, controls, weight and physical dimensions. Nominal performance data is not acceptable.

C. Provide manufacturer's drawings showing layout, schedules, details, piping distribution, valves, branch selector box locations, system risers, and controls diagrams. The drawings shall convey all requirements to successfully install the alternate equipment supplier's system and show no less information than the bid documents.

D. The proposed alternate systems shall meet or exceed the energy ratings as listed in AHRI 1230.

E. The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufacturer's product may not be acceptable or approved.

F. When a substitution of equipment is made, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

1.05 SYSTEM DESCRIPTION

A. The VRF system shall be a heat recovery system with the capability of providing simultaneous cooling and heating to multiple zones or a heat pump system as scheduled.

1. The heat recovery system shall consist of one, two, or three (max.) outdoor heat pump units, branch selectors/heat recovery units (designed for minimum piping and maximum design flexibility), a three-pipe refrigerant distribution system, multiple indoor units, and controls by the equipment manufacturer.
   a. The outdoor units shall be air-cooled direct expansion (DX) type with variable speed inverter driven compressors. The system shall have the capability to connect an indoor evaporator capacity of no less than 130% of the outdoor unit's total capacity.
   b. Every indoor unit or zone shall be independently capable of operating in either heating or cooling mode regardless of the mode of other indoor units. A dedicated hot gas pipe shall be required to ensure optimum heating operation performance.
   c. The system shall be capable of changing mode of individual indoor units or zones (cooling to heating or heating to cooling) within a maximum time of 5 minutes to ensure the indoor temperature can be properly maintained.
   d. A single heat recovery system shall support up to fifty-eight (58) indoor zones.
   e. Two-pipe, heat recovery systems requiring separation of the gas and liquid refrigerant and auxiliary electric heating coils for simultaneous heating and cooling or heating during defrost mode are not acceptable.

f. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a BACnet.

g. Branch Selector/Heat Recovery Unit (BS/HRU) boxes shall be located where shown on the drawings. The branch selector boxes shall contain the refrigerant control piping and electronics to facilitate communications between the BS/HRU and main processor and between the BS/HRU and indoor units. The BS/HRU shall control the operational mode of the subordinate indoor units.

h. If required by the manufacturer, provide insulated condensate drain piping from the BS/HRU to the nearest condensate drain.

2. The heat pump system shall consist of an outdoor unit, a two-pipe refrigerant distribution system, multiple indoor units, and controls by the equipment manufacturer.

a. The outdoor unit shall be air-cooled direct expansion (DX) type with variable speed inverter driven compressors. The system shall have the capability to connect an indoor evaporator capacity of no less than 130% of the outdoor unit's total capacity.

b. The indoor units shall operate in the same heating or cooling mode as all other indoor units connected to a single outdoor unit.

c. A single heat pump system shall support up to fifty-two (52) indoor zones.

B. The indoor units shall be connected to the outdoor unit utilizing the manufacturer specific piping joints, wye-branches and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable.

C. Furnish and install indoor units of the type and capacity shown on the equipment schedules. Units shall be rated in accordance with AHRI Standards.

D. Accessories shall be provided as shown on the equipment specials.

1.06 OPERATING RANGE

A. Heat pump system:

1. The operating range in cooling shall be 23°F to 115°F DB or wider. Provide low ambient operation/wind baffle kit as required for proper operation.
2. The operating range in heating shall be -4°F to 60°F WB or wider. Provide low ambient operation/wind baffle kit as required for proper operation.

B. Heat Recovery system:

1. The operating range in cooling shall be 23°F to 115°F DB or wider. Provide low ambient operation/wind baffle kit as required for proper operation.
2. The operating range in heating shall be -4°F to 60°F DB / -4°F to 59°F WB or wider. Provide low ambient operation/wind baffle kit as required for proper operation.
3. Cooling based simultaneous cooling/heating operating range will be 14°F to 81°F DB or wider.
4. Heating based simultaneous cooling/heating operating range will be 14°F to 60°F DB or wider.

C. Cooling mode indoor room temperature range will be 57°F to77°F WB or wider.

D. Heating mode indoor room temperature range will be 59°F to 80°F DB or wider.

1.07 ADDITIONAL REQUIRED FEATURES

A. Auto charging – Each system shall have a refrigerant auto-charging function. If Autocharging is not available, the manufacturer shall furnish refrigerant charge calculations for each system prior to startup. Included with the project close-out documentation, the installing contractor shall include the actual as-built line lengths with sizes so the manufacturer can rerun the program to determine the required charge.

B. Defrost and Heating Mode – Each system shall maintain continuous heating during defrost operation. If a stage of defrost disables the heating for any period of time, all indoor units associated with the outdoor unit in defrost mode shall de-energize the fans for the duration of the defrost cycle. A defrost cycle shall not exceed five (5) minutes.

C. Oil Return and Heating Mode – Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted.

D. Independent Control – Each indoor unit shall use a dedicated electronic expansion valve for independent control.

E. VFD Inverter Control – Each condensing unit shall use a high efficiency, variable speed "inverter" compressor coupled with inverter fan motors for optimized part load performance. Inverter controlled compressors shall modulate from 4% to 100%. On-off or digital compressor control is not permitted.

F. Compressor capacity shall be modulated automatically to maintain constant suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads.

G. Indoor units shall use Proportional-Integral-Derivative (PID) control loops to control superheat to deliver a comfortable room temperature condition and optimize efficiency. Indoor units shall control to within a +/- one (1) degree F deadband.

H. Connection Ratios – The outdoor unit shall have the ability to connect an indoor unit evaporator capacity of down to 50% and up to 130% of the outdoor unit capacity.

I. Control Wiring – Contractor shall provide and install manufacturer's recommended control wire sizes and types for all systems and system components. Wiring located within a return air plenum shall be plenum rated or installed within conduit. All wiring, installation methods, and terminations shall comply with the NEC.

J. Advanced Diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.

K. Each outdoor unit shall incorporate contacts for electrical demand shedding.

L. Each system shall be capable of integrating with open protocol BACnet and LonWorks building automation systems.

1.08 REFRIGERANT PIPING

A. The system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet from the outdoor unit to the furthest indoor unit, a total combined liquid line length of 3,280 feet of piping between the outdoor unit and indoor units with 295 feet maximum vertical difference without any oil traps or the equivalent. Each system shall have a maximum of 49 feet vertical difference from the highest branch serving indoor units to the lowest branch serving indoor units and this vertical limit must be within the 295 feet vertical

limit between the outdoor unit and the furthest or lowest indoor unit. Manufacturer's factory fabricated piping joints, wye-branches, and headers shall be used to ensure proper refrigerant balance and flow to provide for optimum system capacity and performance. T-style joints are not acceptable as they negatively impact proper refrigerant balance and flow. Where there is a conflict in the Contract Documents, notify the architect/engineer in writing immediately.

B. Refer to Section 23 23 00 – Refrigerant Piping for additional requirements.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment with protective factory installed crating and covering.

B. Store equipment in clean dry spaces to prevent damage and protect from weather, dirt, water and construction debris. Provide protective covers or plastic film over openings to prevent dust and debris from entering the unit or components. Remove all protective coverings prior to final connections or start-up and recycle all recyclable waste.

C. Handle equipment according to manufacturer's written rigging and installation instructions.

1.10 SUBMITTALS

A. Additional information shall be submitted, upon award, in a formal submittal as itemized below. Failure to submit this information with the bid may cause the bid to be rejected. The Vendor shall submit:

1. Product Data: Include refrigerant type and amount of charge in pounds, rated capacities of selected models, weights (shipping, installed and operating), operating characteristics and performances, furnished specialties, and accessories. Equipment tags (that correspond to the tag used on the drawings) shall be clearly noted in the submittal.
2. Evidence of at least 5 successful installations similar in nature, size and scope of this project. Include owner/operator contact information.
3. Training course certificates of completion for qualified installers and supervisors.
4. Shop Drawings: Complete set of manufacturer's certified prints of assemblies, control panels, piping, valves, piping fittings and branches, flow diagrams, risers, sections, elevations, unit isolations, assembled unit dimensions and weights, access requirements, required clearances for maintenance and operation, and wiring diagrams. Submit hardcopies and/or electronic copies in accordance with the General Conditions for Engineer review and approval.
   a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer installed and field-installed wiring.
5. Startup service reports
6. Restart sequence: Provide a description of the sequence for automatic restarting of the equipment after power is restored following a power interruption.
7. Operation and Maintenance Data:
   a. Furnish six (6) sets of written operating, maintenance, controls, and lubrication instructions for all installed systems and equipment. Instructions shall include copies of all designated approved shop drawings, manufacturer's descriptive data, control diagrams, wiring diagrams, and installation and operating instructions as specified.
   b. Submit the above instructions, charts, etc. to the Owner as a rough draft and after the required corrections are made, furnish four (4) sets in hardback binders, suitably indexed and identified.
8. Refrigerant Concentration Limit (RCL) calculations for each system

1.11 WARRANTY

A. The manufacturer shall warrant to the owner that products, system components, equipment, and manufacturer provided piping and accessories will be free from defects in material or workmanship. This warranty applies for a minimum of one (1) year from the date of final installation, or eighteen (18) months from the date of shipment. The contractor shall be responsible for completing all warranty documentation prior to acceptance of the installed systems. Repaired or replacement parts are warranted for the balance of the warranty period applicable to the original part.

1.12 EXTENDED WARRANTY

A. For system components and compressor parts only, the manufacturer shall provide an extended warranty for a total of a five (5) year period. The effective date of this extended warranty shall be established as the date of startup. An installing contractor must provide the following items to the manufacturer in order to qualify for the extended warranty. Doing so will ensure that the contractor has installed the system according to the manufacturer recommendations.

1. The manufacturer's warranty Process/Checklist Sheet
2. Final "as built" VRF select report
3. Commissioning report from Technician Utility Tool (TUT) or the equivalent
4. Before and after digital photographs of test gauge for the pressure and vacuum tests

1.13 COORDINATION

A. Coordinate with the electrical contractor to provide and install dedicated disconnect switches for each indoor unit, each BS/HRU, and each outdoor unit. Sizes shall be per the manufacturer's required maximum overcurrent protection sizing for each piece of equipment. The dedicated disconnects shall also be suitable for the installed location (indoor NEMA-1 or outdoor NEMA-3R).

B. Coordinate with the electrical contractor to confirm all equipment voltage, phase and nameplate data prior to ordering and prior to installation.

PART 2 - PRODUCTS

2.01 OUTDOOR UNIT (HEAT RECOVERY OR HEAT PUMP)

A. General:

1. Outdoor units shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the unit shall consist of scroll compressor(s), motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. Dual and triple frame outdoor units will be field piped with factory designed and supplied Y-branch kits to manifold them together into a single refrigerant circuit.
2. Liquid, hot gas, cold gas (suction lines) must be individually insulated between the outdoor unit and indoor units.
3. Unit control boards shall perform all functions required to effectively and efficiently operate the VRF system and communicate in a daisy chain configuration from outdoor unit to heat recovery and indoor units via a TIA-485 interface.

4. The outdoor unit can be wired and piped with access from the left, right, rear or bottom.
5. Each outdoor unit frame shall have a removable inspection panel no greater than 6 inches tall and 12 inches wide to allow access to service tool connection, DIP switches, auto addressing and error codes.
6. The system will automatically restart operation after a power failure and will include non-volatile memory which will not cause any settings to be lost, thus eliminating the need for reprogramming.
7. The outdoor unit shall be modular in design and shall allow for side-by-side installation with minimum spacing between units.
8. The following safety devices shall be included on the outdoor unit; high pressure sensor and switch, low pressure switch, 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.
9. To ensure the liquid refrigerant does not flash when supplying the indoor units, the circuit shall be provided with a sub-cooling feature.
10. The outdoor unit shall have a centrifugal oil separator for each compressor and controls to ensure sufficient oil supply is maintained for the compressor.
11. Heat pump outdoor unit shall be capable of heating operation at the temperature range limits specified above without additional low ambient controls or an auxiliary heat source.
12. Heat recovery outdoor unit shall be capable of heating operation at the temperature range limits specified above without additional low ambient controls or an auxiliary heat source.
13. 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. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature. If alternative manufacturer's system is incapable of heating during oil return, optional electric heating coil shall be furnished. Contractor is responsible for any change to electrical requirements.
14. The system shall continue to provide heat to the indoor units while in the defrost mode. Reverse cycle defrost during heating operation shall not be permitted due to the potential reduction in space temperature. If alternative manufacturer's system is incapable of heating during defrost, an optional electric heating coil shall be furnished. Contractor is responsible for any change to electrical requirements.
15. Outdoor unit shall have a tested sound rating no higher than 64 dB(A) per outdoor unit frame tested per ISO1996.
16. Each outdoor unit shall be run tested at the factory.

B. Unit Cabinet/Frame:

1. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from galvanized steel panels coated with baked-on enamel paint.

C. Fan:

1. The outdoor unit shall consist of one or more direct-drive propeller type fans with motors that have multiple speed operation via a DC (digitally commutating) inverter. The fan shall be factory set to deliver an external static pressure of 0.12 inches WG. A field setting switch shall allow the external static pressure to be increased to a maximum 0.32 inches WG to accommodate field applied discharge ductwork for indoor mounting of outdoor units.
2. The fan shall be a vertical discharge configuration.

3. The fan motor shall have inherent thermal protection and permanently lubricated bearings.
4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
5. 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 as shown below.

Operation Sound (dB)	Night Mode Sound Pressure Level (dB)
Step 1 max.	55
Step 2 max.	50
Step 3 max.	45

D. Coil:

1. Coils shall be manufactured from rifled bore copper tubes mechanically bonded to aluminum louvered fins to ensure high efficiency performance.
2. The fins shall be covered with a hydrophilic film that is inherently self-cleaning with each rainfall. Manufacturers whose AHRI ratings do not reflect capacity reduction due to coatings are not acceptable.
3. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 and 3.0 microns.
4. The coil shall be protected with an integral metal guard.

E. Compressor:

1. The inverter 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 outdoor unit. 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 or STD ON/OFF) shall be controlled to eliminate deviation from the target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll.
3. Neodymium magnets or manufacturer's equivalent shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The frequency of the inverter compressor shall be variable from 20 to 120Hz and modulate in 1 Hz increments.
5. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment along with an intelligent oil management system.
8. The compressor shall be spring mounted to avoid vibration transmission.
9. Units sized smaller than six (6) tons shall contain a minimum of one (1) compressor. Unit sized for six (6) tons and larger shall contain a minimum of two (2) compressors with a minimum of one (1) additional compressor for each additional four (4) tons of capacity. In the event of compressor failure, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and

associated controls shall be designed to specifically address this condition and initiate an alarm through the control network.

10. In the case of multiple condenser modules, conjoined 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, and completion of defrost.

F. Electrical:

1. A separate power connection will be required for each indoor unit.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet.

G. Control Wiring:

1. Wiring shall comply with NEC Article 800 and these specifications.
2. The control voltage between the indoor, BS/HRU controllers and outdoor units shall be per the manufacturer's installation instructions; typically, low-voltage.
3. Unless directed otherwise in the manufacturer's installation instructions, use 18 AWG, 25pF/ft. Nom., 60.7Ω/Mft impedance, braid or foil shielded, twisted pair wire for TIA-485 daisy chain communications wiring. Splicing of communication wiring shall not be permitted.

2.02 INDOOR AIR HANDLING UNITS

A. General:

1. Indoor air handling units shall be wall hung, cassette type, ducted high static, ducted low static, vertical/horizontal, ceiling suspended, low-profile, or floor mounted type as indicated. Units shall be matched to and compatible with the outdoor units and operate with refrigerant R-410A equipped with an electronic expansion valve and direct-drive DC multispeed fan motor, for installation within a conditioned space.
2. When installed in a vertical configuration the unit shall have a top discharge and a bottom return unless scheduled or noted otherwise.
3. When installed in a horizontal configuration the unit shall have a horizontal discharge and a horizontal return duct connection.
4. Units shall be equipped with a means to reduce the evaporator fan speed once the thermostat is satisfied while limiting changes in room temperature by more than +/- 1°F.
5. Indoor units shall be completely factory assembled and tested. The units shall be complete with factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protection, brazed refrigerant piping connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and a test run switch.
6. Indoor unit refrigerant circuit shall be filled with a dry nitrogen gas charge from the factory.
7. Return air shall be filtered by a factory supplied removable and washable filter with anti-fungal coating.
8. Condensate shall be drained via gravity, integral condensate pump, or external condensate pump. Power for the condensate pump shall match the indoor unit voltage and shall be powered by the same power circuit. Wall mounted units shall have an external condensate pump.

B. Cabinet:

1. The cabinet shall be constructed of galvanized steel with sound absorbing foil-faced insulation to reduce noise and control air leakage.
2. Installation location shall have adequate structural support, space for service access and clearance for air return and supply duct connections.

C. Fan:

1. The fan shall be the manufacturer's standard direct-drive type with a statically and dynamically balanced wheel.
2. The fan motor shall be thermally protected.

D. Coil:

1. Coils shall be of the direct expansion type manufactured from rifled bore copper tubes mechanically bonded to aluminum louvered fins to ensure high efficiency performance.
2. The refrigerant connections shall be the mechanical compression type with flared ends.
3. Condensate drain connection shall be a minimum of ¾ inch inside diameter.
4. A thermistor shall be located on the liquid and gas lines.
5. Units shall be equipped with an electronic expansion valve.
6. Condensate overflow protection must be provided by way of an internal float switch or a float switch installed in the secondary drain outlet. The float switch shall be interlocked to shut down the unit.

E. Electrical:

1. A separate power connection will be required for each indoor unit.
2. Generally, indoor units shall be powered from a 208/230 volt, 1- phase, 60Hz power source. Coordinate with the electrical drawings for additional requirements such as supplemental electric heaters, when specified.
3. Control wiring between the indoor and outdoor unit shall operate at a maximum of 3,280 feet.
4. Control wiring between the indoor unit and the wall mounted controller shall operate at a maximum distance of 1,640 feet; however the zone temperature sensor(s) shall be located within the zone served by the associated indoor unit.

F. Control:

1. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
2. The unit shall be compatible with connection to a BACnet network or interfacing with connection to a BAS system.
3. Individual indoor units shall be provided with a controller. The unit controller, at a minimum, shall have the follow features:
   a. Up to 16 indoor units controllable in one group
   b. Can be combined with a secondary controller for dual operation
   c. Backlit LCD display in English
   d. Temperature sensor with configurable offset
   e. Display of Temperature and Setpoint in 1°F or °C increments
   f. Two display modes: Detailed and Simple
   g. Dual setpoints (individual cooling and heating setpoints) with minimum setpoint differential deadband
   h. Setpoint range limits for Cooling and Heating
   i. Independent cool/heat setback setpoints (unoccupied period)

j. Auto changeover mode can automatically change to cool/heat mode at setpoint +/-1° F
k. Built in 7-day schedule with up to 5 actions per day with independent cool/heat or setback setpoints
l. Automatic adjustment for Daylight Savings Time (DST)
m. 48-hour clock/calendar backup (in case of power failure)
n. Constant monitoring of the system for malfunctions with an immediate display of fault location and condition
o. Prohibit buttons on remote controller
p. Limit selectable operation modes
q. Display can be configured to hide setpoint when unit is OFF. Display shows OFF, instead of MODE when unit is off. Fan speed display can be configured to be hidden when unit is OFF.

2.03 BRANCH CONTROLLER (BC/MCU) BOX FOR VRF HEAT RECOVERY SYSTEM

A. General: The BC/MCU boxes are designed specifically for use with the manufacturer's VRV/VRF heat recovery system components.

1. Selector boxes shall be factory assembled, wired, and piped.
2. Selector boxes shall be run tested at the factory.
3. Selector boxes must be mounted indoors.
4. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve (EEV) (if the system utilizes EEVs).

B. Unit Components:

1. Cabinet shall be fabricated from galvanized steel plates.
2. The BC/MCU box shall consist of electronic expansion valves (EEVs) or solenoid valves that are serviceable and replaceable without opening the refrigeration system.
3. The cabinet shall contain a subcooling heat exchanger (if required for proper operation).
4. The cabinet shall have sound absorptive thermal insulation material made of flame and heat resistant foamed polyethylene.

C. Condensate Removal:

1. The BC/MCU unit shall be provided with condensate removal capability if required by the manufacturer.

D. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and outdoor units shall be per the manufacturer.

2.04 BALL VALVES

A. Refrigerant Isolation Ball Valves shall be provided to isolate BS/HRU units and indoor units. Refer to 3.01.F.

B. Refer to Section 23 23 00 – Refrigerant Piping for additional requirements.

2.05 VRV/VRF CONTROLS NETWORK

A. The Controls Network is made up of local remote controllers, multi-zone controllers, advanced multi-zone controllers, and open protocol network devices that transmit information via the communication bus. The Controls Network shall also have the ability to be accessed via a networked PC or mobile device. The Controls Network supports operation monitoring, scheduling, alarm and error e-mail distribution, general user software, tenant billing, maintenance support, and integration with the Building Automation Systems (BAS) using open protocol via a BACnet interface.

2.06 LG SPECIFIC ADVANCED MULTI-ZONE CONTROLLERS

A. Controllers shall be manufactured by LG Electronics USA, Inc.

B. Controllers shall have a minimum 4¼" backlit LCD.

C. Controllers shall have a time clock with 12-hour format.

D. Controllers shall display temperature values in °F or °C.

E. Controllers shall have continuous room temperature display.

F. Controllers shall be capable of controlling a minimum of 16 indoor units in a control group.

G. Controllers shall be compatible with a twin controller for master/slave control of a control group.

H. Shall have 48-hour minimum power backup.

I. Basic Functions:

1. Configurable to control the air conditioning unit based on remote controller temperature sensor or air conditioning unit temperature sensor.
2. Controls the air conditioning unit or ventilator On/Off
3. Control Mode:
   a. Auto/Cool/Dry/Heat/Fan Only for air conditioning unit
   b. Recovery/Bypass/Auto for ventilator unit
4. Controls the air conditioning unit Occupied/Unoccupied Mode

PART 3 - EXECUTION

3.01 GENERAL

A. VRF equipment, wiring and controls shall be installed as shown on the drawings, specified herein and in strict accordance with manufacturer’s recommendations.

B. Units shall be installed level and plumb. Roof mounted units shall be mounted as shown on the drawings. At a minimum, provide a premanufactured galvanized steel support system suitable for the application; Rectorseal Big Foot or approved equal.

C. Refrigerant line sets exposed to the weather shall be neatly routed and weather protected within a factory fabricated sheet metal duct system; Rectorseal Model RD or approved equal. Support the duct system on the roof with galvanized steel frame type supports with rubber/PVC feet; Rectorseal RPS Series or approved equal. Support spacing shall be per manufacturer’s recommendations.

D. Units shall be installed to allow adequate service to all components and valves. Refer to manufacturer's installation instructions for service and airflow clearance recommendations.

E. The system shall be installed by a factory trained and certified contractor/dealer. The bidders shall be required to submit training certification proof with bid documents and submittals. The mechanical contractor's installation price shall be based on the system's installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements. Contractors shall provide training certificates during the submittal phase. Contactor's certification is subject to validation at any time on the job site during the course of construction.

F. Install a full port refrigeration ball valve with Schrader valve at the BC/MCU connections for each indoor unit and at each indoor unit. Locate valves per VRF manufacturer's recommendations. Refer to Section 23 23 00 – Refrigerant Piping for additional requirements.

G. Installing mechanical contractor shall be responsible for coordinating electric meter capabilities meet the minimum requirements specified above and are fully compatible with manufacturer provided Power Interface Modules (PIM). Electric Meters shall be provided by Electrical contractor.

3.02 INSTALLATION SITE VISITS

A. The manufacturer's representative/vendor shall make periodic site visits during the installation of the systems to ensure that the systems are installed in accordance with the manufacturer's instructions. The individual visiting the site to perform inspections shall have a minimum 3 years of experience in the installation and service of VRF systems and shall be certified by the manufacturer as a trainer/instructor for installation, commissioning, service, and troubleshooting classes. If necessary, this individual may be an employee of the VRF system manufacturer. Certification documentation for the individual visiting the site shall be included in the VRF submittal.

B. The manufacturer's representative/vendor shall provide a written report of any deficiencies found during the installation of the systems. All deficiencies noted by the manufacturer's representative/vendor shall be corrected by the contractor at no additional cost to the contract. The manufacturer's representative/vendor's report and the contractor's responses shall be submitted to the Architect within 2 weeks of the date of the report. The manufacturer's representative/vendor shall make site visits as follows:

1. Within the first week of piping installation.
2. Upon completion of the first floor of piping.
3. A minimum of once per month until the system is completely installed.
4. All piping must be inspected by the manufacturer's representative/vendor prior to concealment.

C. The contractor shall coordinate with the manufacturer's representative/vendor to provide adequate notice for when site visits are required.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service. Service shall include a report that includes any and all requirements the manufacturer requires to support the extended warranty specified. Mechanical installer shall be fully responsible for supporting/coordinating delivery of the required reports to ensure the specified warranty is provided. Startup service shall include the following documentation at a minimum:

1. The manufacturer's warranty Process/Checklist Sheet.
2. Final "as built" VRF select report.
3. Commissioning report from Technician Utility Tool (TUT)/equivalent
4. Before and after pictures of test gauge for the pressure test and vacuum test.
5. Any and all other requirements the VRF manufacturer requires to attain the specified warranty.

B. Verify that the systems are installed and connected according to manufacturer's written instructions and the Contract Documents. Where conflicts exist between the manufacturer's written instructions and the Contract Documents, the manufacturer's written instructions shall take precedence, except in the cases of code compliance issues.

C. Verify that electrical wiring installation complies with the manufacturer's submittal and the installation requirements of Division 26 Sections. Where conflicts exist between the manufacturer's written instructions and the Division 26 Sections, the manufacturer's written instructions shall take precedence, except in the cases of code compliance issues.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance tests have been made, replace all air filters with new filters equivalent to the manufacturer's supplied filters.

3.04 COMMISSIONING

A. Manufacturer shall provide a minimum of two (2) eight (8) hour days of technical support on-site to support the commissioning process.

3.05 SYSTEM OPERATION DEMONSTRATION AND TRAINING

A. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain system components, equipment, and controls (Minimum of one (1) four (4) hour day).

B. Engage a factory-authorized service representative to train the Owner's property management personnel on application software, access, tenant metering reports, creating/modifying reports and logs, and processing notifications and alarms (Minimum of one (1) four (4) hour day).

C. Contractor shall instruct the Owner's designated operating personnel in the proper operation and maintenance of the equipment as well as the operation and maintenance of the controls for the various systems in the building. Informal or unwitnessed instructions, or instructions to non-designated personnel, will not be acceptable. In addition to the instruction periods specified above, furnish classroom instructions for a minimum of one (1) eight (8) hour day. Prior arrangements for instruction periods shall be made with the Owner two (2) weeks prior to the actual training class.

D. Document all training sessions and include attendance lists and complete contact information.

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SECTION 23 8130
VARIABLE REFRIGERANT FLOW HEAT PUMP

PART 1 – GENERAL

1.01 SYSTEM DESCRIPTION

A. Variable Refrigerant Flow (VRF) HVAC system shall be a direct expansion (DX) heat Pump system. The outdoor unit shall consist of one or more frames (modules) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to a rooftop air handling unit through a common refrigerant piping network and integrated system controls and communication network.

B. The outdoor unit shall be an air cooled condensing unit with vertical discharge that uses refrigerant R-410A. The condensing unit may connect an evaporator capacity up to 150% of the condensing unit capacity without any special factory approval. All zones are each capable of operating separately with individual temperature control.

C. Heat Pump systems shall operate in either the heating or cooling mode.

D. Condensing unit shall be interconnected to rooftop air handling units in accordance with the manufacturer's engineering manual. The rooftop air handling unit shall be connected to the condensing unit utilizing the manufacturer specified piping joints and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable for a variable refrigerant system.

1.02 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and shall bear the listed mark.

B. All wiring shall be in accordance with the National Electric Code (NEC). The System shall be rated in accordance with Air Conditioning Refrigeration Institute (AHRI) Standard 1230 and bear the AHRI label.

C. The system shall be manufactured in an ISO 9001 and ISO 14001 facility, in accordance with the standards set by the International Standard Organization (ISO).

D. All units must meet or exceed the 2010 federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems.

E. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230 and ISO Standard 13256-1.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled according to the manufacturer's recommendations.

1.04 VRF

A. Acceptable standards shall be supplied based upon the basis of design VRF model specified. At least 10 days prior to the bid date, alternate manufacturers shall request permission to bid, in writing, from the engineer. This request by the contractor to bid an alternate supplier for the basis of design, listed or not listed, shall not relieve the contractor from supplying all materials, options, controls, sequences, efficiencies, and intent of the original specifications written or implied by VRF model number or model family or as otherwise specified. The written request and engineers' written response to such request shall be included in all submittal documents for approval.

1.05 ALT EQUIPMENT BID INSTRUCTION

A. The contractor shall provide basis of design bid as specified. If the contractor proposes an alternate manufacturer for the basis of designed products they shall provide a separate and complete Bid detailing the proposed alternate products and the associated adjustment of price to support the change from basis of design products. The contractor bids the alternate product with full knowledge that the proposed product may not be acceptable or approved. In no event shall the contractor be entitled to additional compensation to supply such specified products, options or sequences. Any and all additional cost, to any party, because of any product submitted on or supplied other than that of the original specified products shall be the responsibility of the contractor without recourse. It is agreed that any and all disputes regarding any differences between the specified products, options or sequences and that proposed as an alternate shall be arbitrated by the engineer of record. It shall be further agreed by all parties that all decisions of arbitration shall be final and binding. Any product proposed as an alternate shall have been offered, as a VRF product, in the United States for a minimum of (5) years.

1.06 SUBMITTALS

A. A complete submittal package shall be compiled, and 10 copies shall be forwarded to the general contractor who shall supply the architect with the submittals for dissemination to all parties. The submittal shall be a collection of documents that represent the technical aspects of each product or collection of products to be used on the project. All performance submissions shall be calculated at the design temperatures; nominal performance data shall not be allowed. The submission and approval of said submittals does not relieve the contractor from supplying all requirements set forth in the specification and drawings. Any substitutions offered by the contractor shall include, as a separate document, any and all differences between the submitted products and the specified products including but not limited to, all dimensions, electrical, control, weights, warranties, country of origin, and a statement from the manufacture that no child labor has been used in the manufacture or assembly of said products, and a copy shall be supplied with the product outdoor unit submittal.

B. If submittals contain any proposed alternate equipment specifications, calculations, dimensions, electrical specifications, sound specifications or any other mandated submissions which are not accepted, are noted or rejected for any reason, the contractor shall be allowed to correct any deficiency and re-submit a second time. Should there be any issues found on second submission, the contractor will be directed to and agrees to submit on the original specified products and provide the specified products without any additional compensation.

1.07 ROOFTOP AIR HANDLING UNIT

A. The system shall consist roof mounted air handling unit, branch joints and headers. T-style joints shall not be permitted due to the large pressure differential through these fittings. The capacity of the rooftop air handling unit shall range from 55% to 150% of outdoor rated capacity. Up to 150% shall be possible without any factory approval for all capacities. Refer to specification section 23 74 01 for rooftop air handling unit requirements.

1.08 VRF SYSTEM

A. The VRF unit shall be interconnected to the rooftop air handling unit with capacities from 6,000 Btu/h to 96,000 Btu/h. The rooftop air handling unit shall be able to provide set temperature and humidity settings through a wide variety of control options including wired, central station, computerized controller, LONWorks adapter, or BACnet adapter; a VRF H-Link Smart Gateway (BACnet) – compatible device that make manufacturer's

VRF viewable from all BACnet IP BMS/BAS systems; a Web interface and automatic point mapping to the BMS.

B. All components (compressor, controls, etc.) in the Outdoor Unit shall be easily accessible from the front for service/replacement.

1.09 HEATING DEFROST OPERATION

A. The system shall have the ability to use a continuous heating defrost operation for multi-module system configurations.

PART 2-WARRANTY

1.01 LIMITED WARRANTY

A. Refer to the product's Limited Warranty Certificate.

PART 3 – PERFORMANCE

3.01 PERFORMANCE

A. The three-phase VRF system performance shall be rated in accordance with AHRI 1230 test conditions.

B. The VRF system shall be listed in the AHRI directory.

3.02 The system efficiencies shall meet or exceed the scheduled performance criteria.

A. **OPERATING TEMPERATURE RANGES**

B. The ambient air temperature operating ranges shall be as follows:

Category	Range (°F)
Cooling Standard Operating Range (DB) Cooling Extended Operating Range (DB)	23 – 122 -10 - 109
Heating Operating Range (WB)	-13 - 59
Cooling Mode - Indoor Temperature Range (WB)	59 - 73
Heating Mode - Indoor Temperature Range (DB)	59 - 80

C. If an alternate equipment manufacturer is selected, the mechanical contractor shall provide, at their own risk and cost, all additional material and labor to meet ambient operating conditions and performance.

PART 4 – PRODUCTS

4.01 REFRIGERANT PIPING

A. All refrigerant piping shall be installed in accordance with manufacturer's recommendations. No additional sight glasses or filter/dryers shall be required. All field installed refrigerant piping shall be nitrogenized ACR copper tubing and shall meet ASTM B280. All branch piping joints shall be approved by the manufacturer.

B. The three-phase VRF system shall be capable of the following refrigerant piping lengths:

1. Total system piping length: 3,280 ft.
2. Maximum piping length from refrigerant piping branch to indoor unit: 131 ft.
3. Maximum piping length from first branch to furthest indoor unit: up to 295 ft.
4. Maximum vertical separation from outdoor unit to indoor unit, when outdoor unit is above: 360 ft.
5. Maximum vertical separation from outdoor unit to indoor unit, when outdoor unit is below: 360 ft.

6. Reference spec section 23 23 00 for refrigerant piping insulation and accessories.

4.02 DEVELOPMENT GENERATIONS

A. All three-phase VRF outdoor units connected to the same piping system shall be from the same product development generation. Mixing of outdoor units from different development generations in the same piping system is not acceptable.

4.03 LOW AMBIENT AIR TEMPERATURES

A. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions. Operations outside of these conditions are possible and may involve non-continuous operations.
   1. Outdoor Unit
      a) Cooling: 23°F DB to 122°F DB
      b) Heating: -13°F WB to 59°F WB

4.04 GENERAL FEATURES

A. The air-conditioning system shall use R410A refrigerant.

B. The system shall be capable of an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed into the system.

C. Each system shall consist of one, two, or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.

D. Multiple frame configurations shall be field piped together using manufacturer-designed and supplied Y-branch kits and field-provided interconnecting pipe to form a common refrigerant circuit.

E. Refrigerant circuit configuration
   1. The refrigerant circuit shall be constructed using field-provided ACR copper, de-hydrated, and piped together with manufacturer-supplied Y- branches or headers connected to multiple (ducted, non-ducted or mixed combination indoor units to effectively and efficiently control heating or cooling operation of the VRF system. Other pipe materials shall not be allowed.
      a. Each refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.
      b. The condensing unit will be factory charged with R-410A.
      c. Depending on the size and length of the piping when installed, it may require additional trim charging in the field.
      d. The condensing unit shall include a refrigerant charge volume analyzer that includes an automatic refrigerant assessment system to check whether or not the correct amount of refrigerant charge exists in a given refrigerant cycle.

4.05 ELECTRICAL

A. The condensing unit power supply shall be 460V, , 3 phase, 60 Hertz per the electrical plans.

B. The condensing unit shall have an acceptable voltage range of 416-508V,.

C. The control circuit between the units in the system shall use AWG18-2 type control wire.

4.06 SAFETY

A. The condensing unit shall include protection devices including a high pressure switch at 4.15 MPa (601psi), over current protection for the inverter and for the PCB, and over heat protection for the inverter and the compressor
.

4.07 ENERGY SAVINGS

A. The system shall be equipped with power demand limiting control possibility which prevents excessive energy consumption during peak operating conditions and automatically detects electric current flow and prevents the system from using too much energy.

PART 5 – CONTROLLERS

5.01 CIW01-WIRED ZONE CONTROLLER

A. Backlit display
B. Built-in thermistor
C. Standard wall controller
D. Controls temperature, mode, fan speed
E. Seven-day timer with multiple setpoints
F. Controls up to 16 indoor units
G. Built-in 23-hour timer
H. Room name and service company name programmable
I. Help menus and error code diagnosis
J. Large LCD display permits users to see the operating conditions and settings
K. The timer can be set at half-hour intervals
L. Monitors the operating conditions in the system, and an alarm is issued if a problem occurs.
M. A “self-diagnosis function” checks for problems on:
N. printed boards in indoor and
O. outdoor units
P. Temperature range limit
Q. Individual function lockout. (mode, temperature, fan speed)

5.02 CBN02 VRF SMART GATEWAY

A. Supports up to 64 VRF systems, up to 160 Indoor Units, and up to 200 total Indoor and Outdoor Units
B. Integrates with the Metasys and FX building automation systems
C. Integrates with third party building automation systems supporting the BACnet IP protocol
D. BACnet Gateway (B-GW) device profile
E. BACnet IP, (Annex J), BACnet Broadcast Management Device (BBMD)"
F. Connects up to 4 Large Central Controllers (CCCL01) simultaneously to the same H-LINK II segment
G. Includes a Wi-Fi antenna for access via Laptop, Smartphone, etc.

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SECTION 23 9000
MISCELLANEOUS HVAC EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install the equipment as specified below. The manufacturer shall have available factory trained service engineers and an inventory of replacement parts within a one hundred mile radius of the job site.

PART 2 - PRODUCTS

2.01 ELECTRIC WALL HEATERS

A. Heaters shall be surface mounted semi-recessed as scheduled and be of tamper resistant construction.

B. Enclosures shall be 16-gauge, furniture quality steel construction; designed to withstand heavy-duty commercial and institutional use.

C. Enclosures shall be chemically-treated to resist corrosion. Finish shall be marr and temperature-resistant.

D. Heating elements shall be constructed of steel finned metal sheath heating elements with low sheath temperatures to provide uniform heat.

E. Integral thermostat, tamper resistant.

F. Automatic reset thermal overheat protection.

G. Built-in fan delay switch to energize fan only after elements are heated.

H. All heaters and electrical accessories shall be labeled by Underwriters Laboratories Inc.

I. Heaters shall be by Q-Mark, Raywall, Markel or Chromalox.

2.02 UNIT HEATERS

A. Unit shall be of the horizontal or vertical blow-thru propeller fan type.

B. Casing shall be constructed of 18-gauge die-formed, furniture grade steel, phosphate coated and finished in baked enamel.

C. Electric heating element shall be a resistant wire enclosed in a steel sheath with fins.

D. Fan shall be direct drive, propeller type, designed for unit heater application.

E. Motor shall be totally enclosed, thermally protected continuous duty selected to match fan requirements.

F. Unit shall be provided with the manufacturer's standard mounting bracket for either ceiling or wall mounting as required.

G. Unit shall be equipped with individual adjustable louvers.

H. Wiring of unit heater shall be designed for a single source power connection with elements, motor and control circuits subdivided and fused to conform to the latest National Electrical Code, OSHA and Underwriters Laboratories Inc. standards. All three

phase heaters shall have balanced phases. A non-fused disconnect switch factory wired shall be provided. Control circuit voltage shall not exceed 120 volts.

I. Unit heater shall be equipped with an automatic reset linear thermal cut-out, a fan delay switch, control circuit transformer and either a wall mounted or unit mounted thermostat as shown on the Drawings.

J. Units shall be Q-Mark, Markel, Trane, Chromalox or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance with manufacturer's installation instructions.

END OF SECTION

SECTION 25 1300
INTEGRATED AUTOMATION SYSTEM (IAS)
DIVISION 25

PART 1 – GENERAL

1.01 SUMMARY

A. This division describes the Systems Integration scope of work for the project. This division also coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems, furnished by each trade that will be integrated by this Division.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.02 RELATED DOCUMENTS

A. Alarms List Template.
   1. An Alarm List shall be created by the SI with the assistance of the Owner as part of the scope of this project.
   2. Alarms from the BMS system shall be transmitted to a predetermined hierarchy developed with the owner. The alarm delivery method and list of alarms shall be coordinated with the Owner as part of this scope.

B. Points Matrix and Building Management System (BMS) Architecture Drawing.
   1. Points Matrix provided by Division 23 contractor
   2. BMS Architecture Drawings provided by owner as part of the construction documents.

C. Sub-system List
   1. Non HVAC systems connected to the BMS for the purposes of alarming and trending.
   2. Identifies the system, quantity of systems, communication method (I/O or communication protocol) and points needed for integration into the BMS.

D. Section 23 0900 - Direct Digital Control System (DDCS) for HVAC.

E. Section 23 0993 – Sequence of Operations for HVC Controls

1.03 SYSTEM DESCRIPTION

A. The Integrated Automation System (IAS), also described as the BMS, shall be comprised of Network Area Controller(s) (NAC). The NAC shall connect to the owner's local or wide area network, depending on configuration. Field controllers (IDCs) provided by the Division 23 contractor shall connect to the NACs via hard wired connections (preferred) or Ethernet through the owner's local or wide or network. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network.

B. Client has standardized on ASHRAE Standard 135-2010, BACnet/IP and BACnet MS/TP Control System architecture as the preferred communication method for the BMS. Where factory controls or other controls incorporate Modbus RTU or Modbus TCP/IP communication protocols the Division 25 SI shall be capable of integrating these systems into the BMS. The division of work for this project is segmented between Division 23 and Division 25. Division 25 shall be supported by a preselected Systems Integrator (SI). The SI is responsible for coordinating the consistency of the local operator workstation system graphics and coordinating the integration of the local Division 23 (DDC) system into the

global system. The SI shall also oversee control system-specific commissioning/verification procedures to the contractor administered by this Division.

C. All control components such as communication modules, switches, LAN connectors, etc. shall be mounted in cabinets. Control cabinets shall be single door UL enclosures with hinged doors. All cabinets shall be provided with locksets that match.

D. The controls system front end, , shall be based on the Niagara^{N4} Framework - Vykon (or "Niagara^{N4} - Vykon"), a Java-based framework developed by Tridium.
   1. The Division 25 contractor shall provide integration between other devices/sub systems that may not be directly part of the HVAC system, as identified in the bid documents and the BMS for the purposes of alarming and trending.
      a. These systems may include but are not be limited to those identified in the Div 23 sub-system matrix.
      b. Where these systems are provided with a BACnet IP, BACnet MS/TP, Modbus TCP/IP, Modbus RTU, or other communication method the device shall be connected directly to a NAC communication port. The wiring installation and termination for this connection shall be provided by the Division 23 contractor.
      c. Where these systems are provided with outputs/inputs the Division 23 contractor shall provide sufficient wiring and IDC(s) for those points necessary to accurately monitor and/or control the system(s) as indicated on the plans and/or in the points matrix, through connections to a NAC
      d. The Division 25 contractor shall be responsible providing assistance to the Division 26 Contractor and/or the device/system provider in programming/set up of all sub system devices connected to the BMS through a NAC to assure the information is transmitted properly to the BMS.

E. The SI shall also coordinate incorporation of the following components, where applicable, into the BMS:
   1. Air Compressor, supplied with factory-mounted BACnet IP or Modbus TCP interface. Coordinate with Project MHE integrator.
   2. Generator, supplied with factory-mounted BACnet IP or Modbus TCP interface. Coordinate with Division 26.

1.04 SYSTEM INTEGRATION CONTRACTOR QUALIFICATIONS

A. General
   1. The System Integrator shall be CBRE|ESI.
   2. The Contractor shall directly hire CBRE|ESI for system integration – see paragraph 3.1 Section 23 0900 for scope responsibilities. Following is contact information for CBRE/ESI:
      Roland Gutknecht | Account Executive
      CBRE | ESI
      Global Workplace Solutions | Global Energy & Sustainability
      3410 Gateway Road | Brookfield, WI 53045
      T +1 262 832 1311 | F +1 888 280 8837 | C +1 414 507 0999
      Roland.Gutknecht@cbre.com | www.cbre.com | www.thinkesi.com

1.05 PROJECT SUBMITTALS

A. Four copies of shop drawings of the IAS system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturer's catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a

system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.

B. Submittal shall include a network cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

C. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk and on the Network Supervisor (NS) hard drive. Drawings shall be provided as AutoCAD™ version 2006 or later or Visio™ version 2003 or later compatible files. Four copies of the 'as-built' drawings shall be provided in addition to the documents on electronic media or compact disc. Division 23 and 26 contractors shall provide as-builts for their portions of work. Division 25 System Integrator shall be responsible for as-builts pertaining to overall IAS architecture and network diagrams.

1. Division 23 contractor and Division 25 Integrator shall provide drawings in AutoCAD™ version 2006 or later or Visio™ version 2003 or later.

1.06 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
SI	Systems Integrator
ES	Enterprise System
IAS	Integrated Automation System
SCP	Stand Alone Control Panel
DDCS	Direct Digital Control System
BMS	Building Management System
NAC	Network Area Controller
IDC or BC	Interoperable Digital Controller/Building Controller
ASC	Application Specific Controller
PCU	Programmable Control Unit
GUI	Graphical User Interface
WBI	Web Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
BIBB	BACnet Interoperability Building Blocks

1.07 DIVISION OF WORK

A. The Division 23/DDCS Contractor shall be responsible for all field controllers (IDC: ASC, PCU) - when not provided by packaged/factory controls, control devices, sensing devices, control panels, controller programming, controller programming software, controller input/output wiring, power wiring (120VAC and other), interlock and safety wiring, controller network wiring, Ethernet LAN wiring as it pertains to NAC drops or other BMS attached devices, controller I/O wiring, wiring between non-HVAC sub systems and the BMS, sub system programming (as may be required), all terminations, BACnet MS/TP communication or other communication wiring to the NACs, installation of all control panels (including the Division 25 control panels), installation of all control devices, installation of all wiring as well as commissioning and point to point checkout as it pertains to components/systems identified under Division 23.

B. The Division 25 System Integrator (SI) shall be responsible for Network Area Controllers (NAC), NAC control panels, software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, setup of schedules, trend logs and alarms, network management, global supervisory control applications, system integration, coordination of the NAC to the local or wide area network as well as commissioning and point to point check as it pertains to deliverables identified under Division 25. The SI will also be responsible for overseeing point to point check out of the Division 23 deliverables in coordination with and support of the Division 23 contractor to include but not limited to the GUI and global control applications.

1.08 WORK INCLUDED

A. Furnish and install the following application software as outlined in this division.
1. User Interface Software
2. Global and supervisory HVAC application software

B. The following will be coordinated with the owner/owner's agent:

1. Provide custom set-up and development of the software to provide the functional and performance requirements specified. Develop system graphics for all specified mechanical and electrical systems, using animated objects to display all system variables and process valves, according to owner's standards.
2. Provide supervisory control strategies for mechanical and electrical systems to permit the global sequence of operations specified herein.
3. The IAS/BMS shall provide global control, alarm detection, scheduling, reporting and information management for the entire facility as it pertains to the HVAC systems and building sub systems identified in this document and construction documents.

1.09 RELATED WORK SPECIFIED ELSEWHERE

A. Division 23, Mechanical:
1. Providing control devices and systems including but not limited to:
   a. Interoperable Digital Controllers and programming
   b. Sensors, actuators, indicators and interface equipment
   c. Control panels, devices and wiring
   d. Control device networks
   e. Terminations

B. Division 26, Electrical:
1. Providing motor starters and disconnect switches (unless otherwise noted).
2. Power wiring and conduit (unless otherwise noted).
3. Provision, installation and wiring of smoke detectors (unless otherwise noted).

C. Sub-System Device Matrix

D. Points Matrix – Division 23 09 00

1.10 AGENCY AND CODE APPROVALS

A. All products of the IAS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. UL-916; Energy Management Systems
2. UL-508A; Industrial Control Panels
3. ULC; UL - Canadian Standards Association
4. FCC, Part 15, Subpart J, Class A Computing Devices

1.11 SOFTWARE LICENSE AGREEMENT

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

1.12 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.13 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this division with that of other divisions to insure that the Work will be carried out in an orderly fashion. It shall be this System Integrator's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 – MATERIALS

2.01 GENERAL

A. The Integrated Automation System (IAS) shall be comprised of a network of interoperable, stand-alone Network Area Controllers, servers, operator workstations, graphical user interface software, printers, network devices and other devices as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall IAS.

2.02 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-2010 BACnet technology (preferred) or other communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2010, BACnet to assure interoperability between all system components is required. For each BACnet device, the device supplier shall provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet or MS/TP.

C. All components and controllers supplied under the Division 25 specification shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

F. The system must be capable of converting any point desired by the owner into an SNMP value for broadcast from BMS server out through router into owner WAN for customer's use as they see fit. The values shall be communicated in 15 minute intervals.

G. The system must be capable of integrating BACnet/IP, BACnet MS/TP, Modbus TCP/IP and Modbus MS/TP (RTU) communication architectures into the IAS.

2.03 NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, and HTTP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:
   1. Ethernet; IEEE standard 802.3
   2. Cable; 10 Base-T, UTP-8 wire, category 6
   3. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

C. The network shall be provided by the Division 23 or other contractor.

2.04 NETWORK ACCESS

A. Remote Access
   1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

B. Server (Provided by Client)
   1. Minimum performance requirements:
      a. vCPU: 4
      b. Mem (GiB): 16
      c. SSD Storage: EBS-only
      d. Dedicated EBS Bandwidth (Mbps): 750
      e. Operating System – Windows Server 2012
      f. Processor - Intel® Core (i7 or Xeon) 2.3Ghz or higher
      g. Hard Drive –500 GB or larger capacity

2.05 NETWORK AREA CONTROLLER (NAC)

A. The Division 25 Contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. The number of area controllers required is dependent on the type and quantity of devices provided under Divisions 23 and 26. It is the responsibility of the Division 25 contractor to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization
   6. Integration of BACnet controller data
   7. Integration of Modbus controller data

C. The NAC shall be a Vykon JACE-8000
   1. The NAC shall have the following minimum specifications:
      a. 1000MHz Processor or higher
      b. 1GB DDR3 SDRAM or higher
      c. Removable micro-SD card with 4GB flash total storage, 2 GB user storage or higher
      d. 2 isolated RS-485 ports with selectable bias and termination
      e. 2 10/100MB Ethernet ports
   2. A single NAC shall be limited to 4,000 data points or 4,000 histories. If additional data points or histories are required a second NAC shall be added.
   3. The NAC must be capable of operation over a temperature range of 0 to 55°C
   4. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
   5. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

E. Event Alarm Notification and actions:
   1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
   2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
   3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
      a. Alarm
      b. Return to normal
      c. Fault
   4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
   5. Provide timed (schedule) routing of alarms by class, object, group, or node.
   6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

F. Control equipment and network failures shall be treated as alarms and annunciated.

G. Alarms shall be annunciated in any of the following manners as defined by the user:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day

c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

H. The following shall be recorded by the NAC for each alarm (at a minimum):
1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

I. Alarm actions may be initiated by user defined programmable objects created for that purpose.

J. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

L. Provide a “query” feature to allow review of specific alarms by user defined parameters.

M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

N. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

O. Data Collection and Storage:
1. The NAC shall have the ability to collect data for any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
a. Designating the log as interval or deviation.
b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis. A default 672 (7 days at 15 minute interval) records shall be available at the NAC for each point
e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
3. All log data shall be stored in a relational database and the data shall be accessed from a standard Web Browser.
4. All log data, when accessed from the Network Supervisor (NS), shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:
a. HTML
b. XML
c. Plain Text
d. Comma or tab separated values
6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

7. The NAC shall have the ability to archive it's log data to a Network Supervisor on the network. Provide the ability to configure the following archiving properties, at a minimum:
   a. Archive on time of day
   b. Archive on user-defined number of data stores in the log (buffer size)
   c. Archive when log has reached it's user-defined capacity of data stores
   d. Provide ability to clear logs once archived

P. Audit Log
1. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive the log based on time to the Network Supervisor. For each log entry, provide the following data:
   a. Time and Date
   b. User ID
   c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

Q. DATABASE BACKUP AND STORAGE
1. The NAC shall automatically backup its database to the Network Supervisor. The database shall be backed up based on a user-defined time interval (every 24 hours for this project).
2. Copies of the current database and, at the most recently saved database shall be stored on the Network Supervisor. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.06 STAND ALONE CONTROL PANELS (SCP)

A. Furnish control panels of code gauge steel with locking doors for mounting all devices as shown. Panels shall conform to NEMA 1 standards, unless otherwise indicated.

B. Control panels shall meet all requirements of UL508A and shall be so certified and supporting documents provided.

C. Panels shall be constructed prior to delivery to site.

D. For each SCP provide a panel size sufficient for 20% growth of the I/O located within a specific SCP as it pertains to Division 25 delivered I/O.

E. All external wiring shall be connected to terminal strips mounted within the panel.
1. Under no circumstances will field wiring be terminated from inputs or outputs direct to the I/O on the controllers. Further, all spare points meeting the 20% requirement will be pre-wired to terminal strips.

F. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels and the identification number of the panel.

G. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

H. Each panel shall have a pin-hinged door and master keyed lock.

I. Maximum panel depth no more than 9 inches.

J. Each panel shall be capable of proper operation in an ambient environment of 32 to 122 degrees F and 10% to 90% relative humidity

K. Each control panel (SCP) shall be provided with a minimum of one network switch (4 or 5 port) with one port available for local access to entire system from a service laptop if the control device(s) located in the SCP communicate over an IP network.
   1. Managed switches, switches larger than five ports or switches utilized for other resources other than those associated with the BmS shall be provided by others.
   2. Switches housed in SCPs supporting IDCs or other Division 23 provided BMS supporting devices shall be provided by the Division 23 contractor.

L. Each switch provided by the Division 25 contractor shall terminate on a dedicated port on a building wide LAN/WAN switch provided by others. SCP housed switches shall not be cascaded or daisy chained.

2.07 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacturer-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the IAS, shall not be acceptable.

C. The Web browser client shall support at a minimum, the following functions:
   1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
   2. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
   3. Storage of the graphical screens shall be in the Network Area Controller (NAC), the Network Supervisor (NS) or both, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
   4. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
   5. User’s shall have administrator-defined access privileges (provide a minimum of ten user levels). Depending on the access privileges assigned, the user shall be able to perform the following:
      a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
         1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
         2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
      b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
      c. View logs and charts
      d. View and acknowledge alarms
      e. Setup and execute SQL queries on log and archive information
   6. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

7. Signing off the system shall allow the ability to produce a hard copy report of the operator's name, time and date. If an operator should not exercise the system for a period of 15 minutes (adjustable), then the system shall automatically log of that user.
8. In addition to producing reports of valid or invalid sign-on and sign-off attempts, the IAS shall store in nonvolatile memory a historical record of a minimum of 300 systems entries, valid and invalid. This information shall only be available to the operator with the highest access level.
9. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.08 NETWORK SUPERVISOR FUNCTIONS AND HARDWARE

A. A Network Supervisor (NS) shall be provided. The NS shall support all Network Area Controllers (NAC) connected to the control LAN.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

C. It shall be possible to provide access to all Network Area Controllers via a single connection to the Network Supervisor. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the Network Supervisor.

D. The Network Supervisor shall provide the following functions, at a minimum:
1. Global Data Access: The Network Supervisor shall provide complete access to distributed data defined anywhere in the system.
2. Distributed Control: The Network Supervisor shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
3. The Network Supervisor shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
4. The Network Supervisor shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
5. The Network Supervisor shall provide scheduling for all Network Area Controllers and their underlying field control devices.
6. The Network Supervisor shall provide demand limiting that operates across all Network Area Controllers. The Network Supervisor must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
7. The Network Supervisor shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
8. Each Network Area Controller supported by the Network Supervisor shall have the ability to archive its log data, alarm data and database to the Network Supervisor, automatically. Archiving options shall be user-defined including archive time and archive frequency (every 24 hours for this project).
9. The Network Supervisor shall provide central alarm management for all Network Area Controllers supported by the Network Supervisor. Alarm management shall include:
   a. Routing of alarms to display, printer, email and pagers
   b. View and acknowledge alarms
   c. Query alarm logs based on user-defined parameters

10. The Network Supervisor shall provide central management of log data for all Network Area Controllers supported by the Network Supervisor. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
    a. Viewing and printing log data
    b. Exporting log data to other software applications
    c. Query log data based on user-defined parameters

2.09 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Graphics, as a minimum, shall be provided as follows:
    1. Home Screen summary of alarm list, and critical information to include but not limited to: plant tonnage and percent utilization of available capacity, UPS kW usage and percent utilization of available capacity as a minimum.
    2. Floor plans for each floor and roof in the building showing all HVAC and major electrical equipment.
        a. Floor plan maps shall show heating and cooling zones throughout the building in a range of colors (minimum 5) that provide a visual display of temperatures relative to their respective setpoints. The colors shall be updated dynamically as zones’ comfort conditions change. Locations of space sensors shall also be shown for each zone. Floor plan humidity’s shall be represented similarly to zone temperatures. Setpoint adjustment and color band displays shall be provided as a tool for user adjustment.
    3. Air flow diagram for each fan system.
    4. Water flow diagrams for each hot water, chilled water and condenser water system.
    5. Logical and intuitive placement of system values in graphics.
    6. Individual graphics for each piece of mechanical and electrical equipment.
    7. Site floor plan showing local temperature, humidity, dew point and differential pressure points. Temperature to be color coded using thermographic representation of temperature in relationship to setpoint.
    8. User selectable windows for adjustment of system parameters.
    9. Animated graphics shall be used in coordination with system status.
    10. Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. It shall also provide a current status of all I/O points being controlled and applicable to each piece of equipment including analog readouts in appropriate engineering units at appropriate locations on the graphic representation.
    11. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one hour period.

12. The system shall provide protection against excessive demand situations during startup periods by automatically introducing time delays between successive start commands to heavy electrical loads.
13. Upon the resumption of power, the IAS shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.
14. System shall have the ability to ramp open or closed any output to allow for non-instantaneous operation of a device.
15. The operator shall have the ability to override the operation of any SCP command.
16. Modifiable tuning parameters, where available and supported as best practice, shall be provided through the GUI.
17. Status of all NACs with regard to CPU usage and general controller health.
18. Status of all IDCs with regard to communication status.
19. Navigation tree shall be available on the left side of the GUI, to easily navigate to specific pieces of equipment, etc.
20. PUE calculation (contingent on the appropriate level on instrumentation).

D. The GUI shall be programmed to provide a separate graphic/display for:
1. Each piece of equipment monitored or controlled including each terminal unit.
2. Each floor and zone controlled.
3. Each schedule.
4. Each trend.
5. Each report.

E. The graphics shall ensure that the operator is always aware of his position within the system as well as how to easily progress through the graphical hierarchy to select any desired graphic or other source of information.

F. Graphics page layout shall take into consideration future growth of the system and plan accordingly. The SI shall create a GUI which allows for the inclusion of additional statuses and values without requiring major reconstruction of the page layout. The intent is to allow the user who has become acquainted with navigating the GUI to maintain the learned navigation as additional points/systems are added to the BMS.

G. All graphics shall be reviewed by the Engineer and owner at major milestones - 75% and 100% BMS and construction schedule. Contractor shall provide a licensed copy of the program used to generate graphics.

H. Programming Methods
1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.10 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the BACnet specification.

E. The library shall include applications or objects for the following functions, at a minimum:
1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to

reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.
4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
5. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
6. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
7. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple Java-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
8. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other

related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

9. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
10. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.

G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:
1. For BACnet devices, provide the following objects at a minimum:
   a. BACnet AI
   b. BACnet AO
   c. BACnet BI
   d. BACnet BO
   e. BACnet Device
2. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

2.11 ALARM MANAGEMENT

A. Alarm management shall be provided to monitor and direct alarm information to operator workstations. The IAS/BMS shall perform distributed, alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the IAS/BMS ability to report alarms be affected by either the operator or activity at a workstation.

B. A dedicated alarm window shall be provided to view system alarms.

C. On every page, an alarm indication shall flash and an audio alert shall sound when the new alarm occurs. The owner shall be able to click on the alarm indicator and bring up the alarm portal/console for full alarming detail.

D. All alarm or point change reports shall include the point’s English language description, prefaced by site location, and the time and date of occurrence. Time shall be posted in hours-minutes-seconds (PST).

E. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories to provide full flexibility in defining the handling of system alarms. The IAS/BMS shall automatically inhibit the reporting of selected alarms during system shutdown and startup. Users shall have the ability to manually inhibit alarm reporting for each point.

F. Alarms reports and messages shall be directed to a user-defined list of operator devices, email addresses or user categories. When an alarm is delivered, it shall provide the location, time stamp of time of occurrence at the delivery station. Delivery of alarm time stamping alone shall not be acceptable.

G. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 1000 character alarm message to more fully describe the alarm condition of direct operator response.
   1. Each NAC shall be capable of storing a library of at least 200 alarm messages. Each message may be assignable to any number of points in the controller.

H. The MSI shall provide up to 200 custom alarms. These alarms shall be programmed so that selected users shall be provided with necessary alarms. This shall be in addition to the standard alarms provided in the point's matrixes. Vendor shall coordinate with owner and engineer to mask low level alarms during an emergency such that only the most critical and immediate alarms shall be annunciated to these selected users.

I. Alarms shall be generated based on their priority. The Owner and Owner's representatives shall direct the contractor to collect, configure, present and trend critical, major and minor alarm points and graphical representations of objects for conditioned monitoring as designated in the attached Point List.

J. If communication with the Operator Workstation is temporarily interrupted, the alarm shall be time-stamped and buffered in the IAS/BMS. When communications return, the alarm shall be transmitted to the Operator Workstation if the point is still in the alarm condition. Loss of controller function and operator work station function communication shall be alarming events which are simultaneously communicated to owner's Local Onsite Management team and Network Operations Center (NOC).

K. The BMS shall be capable of distributing alarm and other custom message through the customer's internal LAN or WAN. This process shall enable users to receive messages via email and any other network connected devices designed for this purpose.

L. The SI shall construct, in coordination with the Owner, an Alarm Escalation process. The alarm escalation process shall identify the alarm categories, recipients based on alarm category and time of day, process for delivering the alarm message and the escalation process if the alarm is not acknowledged in the appropriate/determined time frame.

2.12 DATA HISTORY

A. The IAS/BMS shall automatically accumulate and store runtime hours for all digital input and output points.
   1. The totalization routing shall be capable of a sampling resolution of one minute or less.
   2. The user shall have the ability to define a warning limit for runtime totalization. Unique user-specified messages shall be generated when the limit is reached

B. The IAS/BMS shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.
   1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. kWh, gallons, BTU, tons, etc.).
   2. The totalization routine shall have a sampling resolution of one minute or less.
   3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

C. The IAS/BMS shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for all points.
   1. The event totalization feature shall be able to store the records associated with a minimum of 9,999.9 events before reset.
   2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached

D. All trend data shall be available for use in 3rd party personal computer applications.

E. All trend data shall be available for a period of two years and operate on a first in – first out basis (FIFO).

2.13 DATABASE BACKUP

A. In the event of the server failure, the operator shall not be required to manually reenter system data.

B. The process of database backup shall be an on-line process. While this process is being executed, any other system operations (such as operator input/output, scanning of field hardware, application software execution, etc.) shall not be interrupted.

2.14 SYSTEM INTEGRATION (OTHER):

A. For sub systems (provided by others) that require integration into the IAS/BMS see the sub-system matrix found in Division 23.

B. Where these systems are provided with a BACnet IP, BACnet MS/TP, Modbus TCP/IP, Modbus RTU, Lon Talk or other communication method the device shall be connected directly to a NAC communication port .The wiring installation and termination for this connection shall be provided by the Division 23 contractor.

C. Where these systems are provided with outputs/inputs the Division 23 contractor shall provide sufficient wiring for those points necessary to accurately monitor and/or control the system(s) as indicated on the plans and/or in the points matrix, through connections to a NAC.

D. The Division 25 contractor shall be responsible providing assistance to the Division 26 Contractor and/or the device/system provider in programming/set up of all sub system devices connected to the BMS through a NAC to assure the information is transmitted properly to the BMS.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All work described in this division shall be performed by a system integrator that have a successful history in the design and installation of integrated control systems in multi-site, mission critical Data Centers. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience. Include references and relevant project examples.

B. Install system and materials in accordance with manufacturer’s instructions, and as detailed on the project drawing set. Installation of NAC panels shall be the responsibility of the Division 23, Controls Contractor.

C. Drawings of IAS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with the specifications in Divisions 23 and 26.

3.02 WIRING

A. All electrical control wiring to the NACs and network components (routers, hubs, switches, etc.) shall be the responsibility of the Division 23, DDCS Contractor.

B. All electrical power wiring to the NACs and network components (routers, hubs, switches, etc.) shall be the responsibility of the Division 26, Electrical Contractor.

C. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All IAS/BMS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 26) unless otherwise allowed by the National Electrical Code or applicable local codes. Where IAS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.03 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Acceptance of project by owner will be for entire project, not phased by equipment startup.

C. All work shall have a single warranty date, even when the Owner has received beneficial use due to early system start-up. If the specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

D. Within this period, upon notice by the Owner, any defects in the work provided under this division due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the DDCS Contractor at no expense to the Owner.

3.04 WARRANTY ACCESS

A. The Owner shall grant to the Division 25 System Integrator, reasonable access to the IAS/BMS during the warranty period. The owner shall allow the System Integrator to access the IAS/BMS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.05 ACCEPTANCE TESTING

A. Upon completion of the installation, the Division 25 System Integrator shall load all system software and start-up the system. The Division 23 contractor shall perform all necessary calibration, testing and debugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications. The Division 23 contractor and the Division 25 System Integrator are to coordinate the checkout of the system such that each Division has a representative present during system checkout.

B. The Division 23 contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation. The Division 25 System Integrator shall have a representative present during system checkout by the Division 23 Contractor.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. System Acceptance: Satisfactory completion is when the Division 23, 25 and 26 contractors have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner’s Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.06 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the IAS hardware and software has been established the Division 23 contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. The Division 25 System Integrator shall provide 16 hours of instruction to the owner's designated personnel on the operation of the IAS/BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the IAS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

1. The training shall be in three sessions as follows:
   a. Initial Training: One day session (4 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owner’s personnel can start to familiarize themselves with the system before classroom instruction begins.
   b. First Follow-Up Training: Two days (2 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
   c. Warranty Follow Up: Two days (2 hours total) in no less than 1 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.
2. Schedule training for Owner designated personnel with at least 7 days prior notice. Training sessions which are not scheduled or other unauthorized instruction periods are not included in the required minimum 8 hours of dedicated instruction time.

PART 4 - SEQUENCES OF OPERATION

4.01 SUMMARY

A. The Division 25 System Integrator shall refer to this Item under Division 23 to determine the level of control functionality the Network Area Controller must provide, which is the responsibility of this Division. It is the responsibility of the Division 25 System Integrator to coordinate control functions, such as scheduling and supervisory-level global control with the Division 23 contractor.

PART 5 - POINT LISTS

5.01 SUMMARY

A. The Division 25 System Integrator shall refer to this Item developed and provided under Division 23 to determine the data in the local controllers that must be integrated into the Network Area Controller, which is the responsibility of this Division. It is the responsibility of the Division 25 System Integrator to coordinate control functions, such as scheduling and supervisory-level global control with the Division 23 contractor.

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SECTION 26 0000
ELECTRICAL GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work to be done under this section of the specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of systems for power, lighting, signals and all other work indicated on the drawings or as specified herein. A 100% operational building and electrical distribution system up to a connection point for Owner furnished equipment will be provided.

C. The drawings and specifications are complementary to each other and what is called for by one shall be as binding as if called for by both.

1.02 STANDARDS

A. All work shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:

1. 2020 Edition of the National Electrical Code (NFPA 70) with local Amendments
2. 2015 Edition of the International Building Code with local Amendments
3. 2015 Edition of the International Fire Code with local Amendments
4. Regulations of the local utility company with respect to metering and service entrance
5. Local city and county ordinances governing electrical work
6. Americans with Disabilities Act (Public Law 101-336)
7. 2015 Edition of the International Energy Conservation Code or ASHRAE 90.1-2016

1.03 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.04 WORK INCLUDED

The electrical systems installed and work performed under this division of the specifications shall include but not necessarily be limited to those listed below. All materials and appliances, obviously a part of the electrical systems and necessary to its proper operation, but not specifically mentioned or shown on the drawings, shall be furnished and installed without additional charge.

A. Power Distribution System

B. All lighting systems (indoor and outdoor, normal, emergency and exit) including all fixtures, lamps, plaster and/or tile frames, standards, switches, outlets, wiring, dimmers, contactors, time clocks, photocells, batteries, raceways and other components and fittings required for complete lighting systems

C. Wiring, including power circuit connections for HVAC, plumbing and other mechanical equipment

D. Grounding Systems

E. Temporary service lighting and power system

F. Low voltage system raceways and equipment mounting boards as indicated on the drawings

G. Underground raceway excavation, backfill, and compaction

H. Concrete work for duct banks, manholes, covering, lighting standard bases and equipment bases (where not assigned to General Contractor)

I. Lightning Protection System

J. Electrical Equipment Identification

K. Supporting Devices for Electrical Components

L. Work as required by electric and telecommunication utilities, as well as the coordination of additional work (i.e. work performed by the utility) with that of other trades

1.05 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment and conduit. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to rearrange conduit or equipment, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, the Engineer must be advised of the situation before work is advanced to the point where extra costs will be involved.

E. All additional circuit connections to panelboards must be preapproved by the Engineer.

F. The location, arrangement and extent of equipment, devices, conduit, and other appurtenances related to the installation of electrical work shown on drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

G. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering lighting fixtures. Notify the Engineer of any discrepancies.

H. Review all architectural drawings for door swings, cabinets, counters and built-in equipment.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Electrical equipment. Manuals shall include copies of

control schematics, sequences of operation, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturer's drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

1.07 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Contract Drawings that reflect all changes and that accurately show actual final construction, and deliver these drawings to the Architect.

1.08 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment names in specifications or on drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction and capacities. The "equal" equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Submittals for "equal" products shall be made at least ten (10) days prior to bid (refer to the General Conditions of these specifications). The Engineer shall consider the use of the "equal" equipment based on the supportive documentation available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall, in all cases, be final.

D. The Contractor shall coordinate the installation of all electrical equipment proposed for use in this project with all building trades (architectural, structural, mechanical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy the plans and specifications.

E. If substitutions are made in lieu of equipment specified, the manufacturer's literature shall be submitted to the Engineer for approval. In the case of lighting fixtures, full IES photometric test reports for the fixture, lamp(s), and lenses shall be submitted for approval.

1.09 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.

1. Submit a listing of all the materials indicated below, with the type of material, manufacturer and catalog or model number for each (where applicable):

<u>Package #1</u>
Conductors

Conduit
Multiconductor Cables
Wiring Devices and Plates
Disconnect Switches
Time Switches
Photocells
Lighting Contactors

2. Submit complete shop drawings of the following when supplied by the electrical contractor:

<u>Package #2</u>
Fuses and/or Circuit Breakers
Short Circuit and Coordination Study
Switchboards
Transformers
Surge Protective Devices
Motor Control Centers with typical schematic of starters
Panelboards and Cabinets
Cable Tray and Tray Fittings
Busway
<u>Package #3</u>
Lighting Fixtures
Occupancy Sensors
Lighting Control Panels
<u>Package #4</u>
Generator Set
Transfer Switch
<u>Package #5</u>
Lightning Protection

3. Submit test reports as required in section 3.7 - Electrical Testing.

B. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of shop drawings by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines at no additional cost.

D. All shop drawings shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

1.10 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Work shall not be performed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated equipment installed should they interfere with the proper installation and mounting of mechanical equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.11 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

1.12 TEMPORARY LIGHT AND POWER

A. The Contractor shall provide a temporary service of the amperage and voltage required by the Project Manager.

B. Sufficient wiring, outlets and lamps shall be installed to ensure proper lighting in accordance with OSHA, state and municipal codes. Refer to Division 1 specifications for requirements.

1.13 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings including mechanical, plumbing and other equipment drawings and other divisions of the specifications for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service.

B. Prior to installing material such as electrical equipment, devices, feeders, or branch circuits serving equipment of all other trades, the Contractor shall coordinate with the electrical requirements of the equipment to be installed.

1.14 MECHANICAL SYSTEMS COORDINATION

A. All control wiring for mechanical systems shall be installed under Division 23.

B. Motor controllers (starters) shall be furnished under Division 23 and installed under Division 26, unless specified otherwise.

C. Power wiring to all motors and motor controllers and between motors and controllers shall be provided in Division 26.

D. Power wiring and connections to mechanical louvers shall be coordinated with the mechanical contractor and provided by the electrical contractor. Large louvers may require multiple actuators which will require multiple electrical connections to a single louver. Electrical contractor is responsible for making all required connections.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. The published standards and requirements of the National Electrical Manufacturers Association, the American National Standard Institute, the Institute of Electrical and Electronic Engineers, and the American Society of Testing Materials, are made a part of these specifications and shall apply wherever applicable.

2.02 IDENTIFICATION

A. Equipment or devices specified in the individual sections to be identified shall be identified by machine cut stencil unless the equipment is identified by the manufacturer. Identification of flush mounted cabinets and panelboards shall be on the inside of the device. Surface mounted equipment shall be identified on the outside cover. Equipment operating on 208Y/120 volt normal power system shall be identified with black labels with white inner core, 480Y/277 volt normal power equipment with white labels with black inner core. Equipment operating on 208Y/120 volt emergency power system shall be identified with red labels with white inner core, 480Y/277 volt emergency power equipment with white labels with red inner core.

B. All switchboards and panelboards supplied by a feeder shall be stencil-labeled to indicate the equipment where the power supply originates.

C. All electrical outlets shall include a permanent label affixed to coverplate indicating panel and circuit designation serving the outlet.

D. All labels must be sufficiently durable to withstand a 15 second mineral spirit rub, followed by a 15 second water rub with a soft cloth test. Labels must remain legible with no curling of edges permitted. Provide Brady B-595 vinyl film with permanent adhesive labels or equal.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Mounting heights, unless otherwise noted, are to be center line of the equipment and/or device except the mounting height of suspended light fixtures which is to the bottom of fixture.

B. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.02 EXCAVATION, TRENCHING & BACKFILLING

A. Contractor shall call underground utilities locator company before digging.

B. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.

C. Barriers shall be provided to protect landscaping adjacent to the excavation area.

D. When rocks, concrete or other debris are encountered during excavation, remove completely.

E. Where sidewalk sections must be removed for installation of underground ducts, remove the sidewalk sections completely from joint to joint.

F. Where asphalt must be removed for installation of underground ducts, saw cut the asphalt in two, straight, parallel lines.

G. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.

H. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.

I. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.

J. Backfill the last 6 inches with clean topsoil. Reseed lawn areas.

K. Restore concrete sidewalks and asphalt.

L. The Contractor shall perform all excavation to install the work herein specified and as indicated on drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling shall be done except under pavement.

M. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

N. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 98% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be red for electrical lines and orange for telephone and shall be identified as to the type of line.

O. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.03 STORAGE AND PROTECTION OF MATERIALS

A. Refer to the general requirements section of the specifications, Division 1, for storage, protection, and handling requirements.

B. Inspect materials upon arrival at project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material.

C. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact.

D. Containers which are broken, opened, watermarked, or otherwise damaged materials are unacceptable and shall be removed from premises.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.04 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for electrical equipment where required.

B. Provide 4" thickness housekeeping pads at floor mounted equipment, covering entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.05 PAINTING

A. Except as otherwise specified, painting shall be accomplished under Painting Section. Surfaces shall be left clean of debris and free from oil and other substances which would prevent paint bond.

B. Touch up finishes of factory painted apparatus where finish is marred during installation.

C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.

D. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.06 WORKMANSHIP

A. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components.

3.07 ELECTRICAL TESTING

A. Furnish all labor, materials, instruments, supplies, and services and bear all costs for the accomplishment of the tests herein specified or requested at job site. Correct all defects appearing under test, and repeat the tests until no defects are disclosed, leave the equipment clean and ready for use.

B. All grounds, crosses, shorts, etc., must be eliminated from the wiring. Test all lighting fixtures, together with switches and controls; test the operation of all motors, controllers, and other electrical equipment devices.

C. The switchboard and all feeders shall be Meggar tested. A copy of all test reports shall be given to the Engineer.

D. The Contractor shall perform any tests other than herein specified which may be required by the Engineer or the authority having jurisdiction.

E. Perform the following tests after installation but before energizing the equipment. The following tests and procedures apply to all equipment and material that is to be tested under this Contract.
   1. Transformers
      a. Visually inspect all components for damage, check bushings and insulators for cracks; transformer casing for evidence of leakage; pressure, temperature and liquid level gauges for proper indications.
   2. Ground Resistance
      a. Visually inspect for specified ground connections.
      b. Perform ground resistance test at all connections to switchboards and panelboards.
      c. Use three point or fall of potential method.
      d. Verify single point connection (at the counterpoise) between the grounded and grounding systems.
      e. Additional ground rod is required if resistance is greater than 25 ohms.
   3. Switchboards and Panelboards
      a. Visually inspect all components for damage.
      b. Check operation of circuit breakers/fusible switches.
   4. Ground Fault Systems
      a. Visually inspect for damage and improper connections.
   5. Transfer and Other Relay Schemes
      a. Investigate intended function and verify correct operation.
   6. Electrical Thermography Testing
      a. Provide an Electrical Infrared Inspection and summary report of all building switchboards and panelboards. Utilize Level 1 Certified Infrared Thermographers to perform NETA thermographic testing. Testing shall be performed no less than 11 months after completion with all panels under normal operating mode.
      b. All deficiencies shall be identified in a report showing thermographic and digital images, along with proposed actions. Deficiencies should be corrected by the electrical contractor.
      c. Follow up testing shall be performed to verify that corrections have been completed satisfactorily.
      d. NFPA 70E-compliant personal protective equipment shall be worn by the consultant.

F. The Engineer shall be notified immediately of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.

G. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to meet the specified requirements.

3.08 COMMISSIONING

A. The following systems shall be commissioned in accordance with the requirements of the ASHRAE 90.1 2016:
   1. Occupant Sensor controls
   2. Time Switch controls
   3. Daylight responsive controls

B. Programming of sensors, controls, switches, schedules, VFD operation and other systems shall be set by the installing contractor.

C. The following shall be provided to the building owner or owner representative within 90 days after the date of system acceptance.

4. Submittals, Shop drawings
5. Installation instructions, operations and maintenance instructions for each piece of equipment and system installed.
6. Maintenance schedule
7. Names and address of at least one service agency.
8. Lighting controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set-points shall be permanently recorded on control drawings at control devices or for digital control systems, in programming comments.
9. A complete narrative of how each system is intended to operate, including suggested setpoints.

3.09 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner's key personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all equipment and systems.

END OF SECTION

SECTION 26 0519
CONDUCTORS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conductors, complete, as indicated on the Drawings and as specified herein. Provide a complete system of wiring with all feeders and branch circuits as shown on the Drawings. The wiring system shall be complete to each and every outlet and apparatus shown on the Drawings which requires electrical connections.

B. This section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts or less.

1.03 COLOR CODING

A. Color coding shall be as follows:

120/208 Volt System	277/480 Volt System
Phase A –Black	Phase A - Brown
Phase B – Red	Phase B - Orange
Phase C – Blue	Phase C - Yellow
Neutral – White	Neutral - Gray
Ground – Green	Ground - Green
Isolated Ground - Green with yellow strip (where applicable)	

(Verify color-coding with local code Authority and use local code requirements if and only if the above color code is not acceptable to local authority.)

B. All wire shall be color coded throughout its entire length. Colored phase tape is not allowed.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Wire shall be Southwire/SIMpullTM, Pirelli, Rome, General Cable, Senator, United Copper Industries, Alcan, AFC, or approved equal.

2.02 CONDUCTORS

A. Conductor Material: Unless noted otherwise, conductors shall be copper, 98.5% conductivity except where specifically noted otherwise on Drawings.

B. All wire and cable for feeders and branch circuits shall have copper conductors and shall be 600 volts, 90 degrees C, NEC type conductors with THHN/THWN-2 insulation.

C. Wire No. 8 AWG and larger shall have stranded conductors. Wire No. 10 AWG and smaller shall be solid conductor type.

D. No conductor shall be smaller than No. 12 AWG unless otherwise specified or noted.

E. Branch circuit wiring which supplies more than one fluorescent fixture through the wiring of other fixtures shall be high temperature wire approved for such use.

F. Pulling lubricant is neither required nor allowed for Southwire/SIMpull™ conductors.

2.03 ALUMINUM CONDUCTORS

A. Where substituted for copper conductors, aluminum conductors shall match or exceed copper ampacity.

B. Aluminum conductors shall be compact, Alcan, or Southwire. Conductors shall be AA-8000 series.

C. Aluminum conductors shall not be used for branch circuits, and shall not be installed to any vibrating equipment (e.g. mechanical equipment, transformers, elevators, fire pumps). Minimum rating of feeder size shall be 100 amps.

D. Mechanical screw-type connectors shall comply with the following:
   1. Connectors shall be dual rated (AL7CU or AL9CU) and listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
   2. Using a suitable stripping tool, to avoid damage to the conductors, remove insulation from the required length of the conductor.
   3. Wire brush the conductor and apply a listed joint compound.
   4. Tighten the connection per the connector manufacturer's recommendation.
   5. Wipe off any excess joint compound.

E. For connection to aluminum bus, the following hardware shall be used:
   1. Bolts: Anodized alloy 2024-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
   2. Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
   3. Washers: Flat aluminum alloy 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2.
   4. Lubricate and tighten the hardware as per the manufacturer's recommendations.

F. For connection to copper bus, the following hardware shall be used:
   1. Bolts: Plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to ASTM A-325 or SAE grade 5.
   2. Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B.
   3. Washers: Should be steel, Type A plain standard wide series conforming to ANSI B27.2.
   4. Belleville conical spring washers: shall be of hardened steel, cadmium plated or silicon bronze.
   5. Lubricate and tighten the hardware as per the manufacturer's recommendations.

G. Aluminum conductors shall not be used where expressly forbidden by the local electrical inspections department or plan review board of jurisdiction. The electrical contractor shall verify this requirement prior to bid.

H. Aluminum conductors shall not be connected to equipment which is not UL Listed for aluminum.

2.04 METAL CLAD "MC" CABLE

A. Where allowed by the authority having jurisdiction, the use of metal clad cable is permitted as described below and shall meet all the requirements of the following codes and standards:
   1. Underwriters Laboratories Inc. 83, 1479, 1569, and 1581
   2. National Fire Protection Association NFPA 70, Article 330
   3. All local codes and municipal ordinances.

B. The conductors of the metal clad cable shall comply with Articles 1.3 and 2.2 of this same section.

C. Unless noted otherwise on drawings, MC cable shall be limited to branch circuits concealed in walls, above ceilings and within electrical rooms. For MC cable circuits powered from a surface-mounted panelboard, cable homeruns shall be installed to a metal wireway above the panelboard, and conductors (without armor) shall be routed within metal conduit(s) from wireway to panelboard. Ampacity adjustment factors are not necessary for conduit lengths of 24" or less.

D. MC cable shall not be allowed for wiring to mechanical equipment.

E. Unless noted otherwise, the metal clad cable shall be **MC** with either a galvanized steel jacket or aluminum interlocked armor, a Mylar assembly covering tape, rated at 90 degrees centigrade, with either a green insulated grounding conductor or MC^{AP} Type MC cable with interlocked armor that is listed and identified for grounding, and rated for a maximum of 600 volts.

F. Refer to National Electrical Code Article 330 for uses not permitted.

G. Cables installed in other than vertical runs through bored or punched holes in wood or metal framing members, or through notches in wooden framing members and protected by a steel plate at least 1/16 inches thick, shall be considered supported and secured where such support does not exceed six (6) feet intervals.

H. Cables containing four or fewer conductors sized not larger than No. 10 AWG shall be secured within 12 inches of every box, cabinet, fitting or other cable termination.

I. Metal clad cable shall not be installed outside the building without written authorization from the Engineer.

J. MC cable conductors shall be color coded per specification 260000.

K. Metal clad cable may be utilized in the warehouse to serve branch circuit wiring only (not feeders). If utilized for branch circuit wiring, MC cable shall only be run horizontally and be run along the top chord of the structural joists in the deck fluting. MC cabling shall not be run exposed vertically and shall not be run along the bottom of the structural joists. Transition to EMT for vertical runs shall be made in the horizontal plane at all locations. MC cable shall be installed in a neat and workman-like manner.

2.05 ACCESSORIES

A. Wire Joints: T & B "Sta-Kon," Scotchlok Type "R," Ideal No. 452 or 453, or Buchanan "B-Cap."

B. Cable Connectors: Solderless Type O.Z. "circular clamp type" or T & B "lock-tite" appropriate for the particular application involved.

PART 3 – EXECUTION

3.01 PREPARATION

A. Lubricant: No grease, oil or lubricant other than powdered soapstone or approved pulling compound shall be used to facilitate the pulling of wires. Lubricant shall not be used for conductors with SIMpull™ insulation.

3.02 INSTALLATION

A. Complete electrical systems shall be provided as shown on the Drawings and/or as specified herein.

B. Wires shall be pulled without excessive strain to prevent damage to conductor or insulation. Provide pull boxes as required to facilitate pulling of wire.

C. Prior to energizing, all service and feeder cables shall be tested with megohm meter to determine insulation resistance levels. Test report shall be submitted to the Engineer.

D. Each raceway indicated by symbol on Drawings shall contain three (3) No. 12 AWG wires unless otherwise noted, scheduled or indicated. Hatch marks on raceway symbols indicate the number of conductors in a raceway when the number exceeds three (3).

E. At each fixture or device outlet, a loop or end of wire not less than 6" long shall be left for connection to fixture or device.

F. Splices, taps and connections shall be made up as follows:
   1. Wire sizes No. 10 AWG and smaller with wire nuts.
   2. Wire and cable of sizes No. 8 AWG and larger, with insulated mechanical or crimped connectors.

G. Perform conductor tests as described in Section 26 0000 - Electrical General.

END OF SECTION

SECTION 26 0526
GROUNDING

PART 1 – GENERAL

1.01 DESCRIPTION

A. The work required under this section of the Specifications consists of furnishing, installation and connections of the building grounding system. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be 3-phase, 4-wire grounded wye system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.02 REGULATORY REQUIREMENTS

A. Install a complete grounding system in accordance with the National Electrical Code.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All materials shall be new, UL Listed, and bear a UL Label.

C. Refer to Section 26 0519 - Conductors for conductor specification.

2.02 GROUNDING CONDUCTORS

A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the Drawings.

B. Equipment grounding conductors shall be green insulated conductors sized as indicated on the Drawings. Where size is not indicated on the Drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.

C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.03 PANELBOARDS, TRANSFORMERS, AND DISCONNECT SWITCHES

A. Provide each low voltage distribution and branch circuit panelboard with a copper equipment grounding bar brazed or riveted to the associated enclosures or cabinet and an insulated neutral bar.

B. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.04 DEVICES

A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.05 GROUND RODS

A. Ground rods shall be 3/4" x 10'-0" copper clad steel.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Ground all non-current carrying parts of the electrical system including raceways, equipment frames and enclosures, outlet boxes, junction boxes, and other conductive material in close proximity with electrical circuits.

B. Service entrance and separately derived electrical systems, grounding electrode system

1. The grounded conductor(s) of the electrical service serving the premises wiring system shall be connected to the neutral bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the Drawings. Grounding electrode conductors shall be installed rigid, nonmetallic conduit to point of ground connection, unless subject to physical damage in which case it shall be installed in galvanized rigid steel.
2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity.
3. Bond together the following systems to form the grounding electrode system. All system connections shall be made to the electrodes as close as possible to the service entrance equipment and each connected at the service entrance equipment neutral bus. Do not connect electrode systems together except at neutral bus.
   a. Cold water piping system
   b. Ground rod system
   c. Rebar in concrete footing
   d. Structural steel metal building frame
   e. Lightning protection system
4. Ground the neutral of all dry type transformers to either building steel or a common grounding electrode conductor connected to a service ground. Transformers shall be bonded to the nearest available point on the interior water piping system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. All grounding electrode conductors shall be installed in a raceway system, not exposed to view.
5. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the Drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL Listed mechanical ground clamps.
6. Where there is more than one service to a building or interconnected buildings, services shall be connected by means of a grounding electrode conductor.
7. Bonding shall be in accordance with the National Electrical Code.
8. Install ground rods where indicated on the Drawings with the top of the ground rods 12 inches below finished grade.
9. Ground the neutral and frame of the emergency generator to building steel and the main electrical service ground rod system. In reinforced concrete structures building steel shall be considered to be reinforcing steel or vertical columns. Make connection to building steel with chemical weld type connector, in a location in unfinished space where the connection will not be subject to physical abuse.
10. Generator ground and neutral connections shall be bonded together.

C. Equipment Grounding Conductor

1. Grounding conductors for branch circuits are not shown on the Drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables.
2. Grounding conductors for feeders are typically indicated on the Drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the Drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.

D. Other Grounding Requirements

1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the “point of grounding” of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as “point of ground.” Terminate conductor by stapling to backboard.
2. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by chemical weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.

3.02 TESTING

A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the “Electrical Testing” section of Section 26 0000 - Electrical General. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within 48 hours of rainfall.

END OF SECTION

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SECTION 26 0530
FIRESTOPPING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 26 shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Firestopping for Electrical Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Typical firestopping installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful Contractor shall meet or exceed all requirements described in this document.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all Firestopping Materials.

PART 2 – PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Firestopping manufacturer(s)
   1. FlameStopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
   2. Tremco Inc. (Firestop Cast in Place Sleeves, Caulks, QuickComm Sleeves, QuickComm Units, Pillows, Putty Pads, Outlet Box Inserts, Silicone, Composite Sheets, Collars, Devices)
   3. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
   4. Hilti (Putties, Caulks, Sealants, etc.)

2.02 TYPES OF PRODUCTS

A. Firestop Products
   1. Intumescent Firestop Sealants and Caulks
   2. Acrylic Firestop Sealant and Caulks
   3. Silicone Firestop Sealants and Caulks
   4. Cast in Place Devices
   5. Firestop Putty, Putty Pads
   6. Outlet Box Inserts
   7. QuickComm Sleeves
   8. TREMstop Straps
   9. Firestop Collars
   10. Wrap Strips

11. Firestop Mortar
12. Firestop Pillows
13. Accessories: Forming/Damming Materials: Mineral Wool, Backer Rod or other type as per manufacturer recommendation.

B. Firestop Devices
1. Thru-Wall Fitting (FlameStopper by Wiremold)
   a. The firestop device box shall be constructed of 16-gauge G90 steel.
   b. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375 degrees F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
   c. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16-gauge G90 steel with No. 10-32 screws use to adjust opening size.
   d. The firestop device shall be available for 2" and 4" trade size EMT conduit.
   e. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.
2. Fire Rated Cable Pathway (STI EZ-PATH)
   a. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0 - 100% cable fill.
3. Tremco (QuickComm Unit) 24" x 12" or 34" x 18"
   a. Fire rated steel frame with an intumescent channel. UL Tested for large openings with 100% visual cable fill. UL Tested for Concrete Floors, Block Walls, Dry Walls and Hollow Core Floors.
4. Tremco (QuickComm Sleeve)
   a. Fire rated steel sleeve with an intumescent inner sleeve. UL Tested for Concrete Floors, Block Walls, Dry Walls, Hollow Core and Fluted Decks.

2.03 UL CLASSIFICATION

A. Thru-Wall Fitting: The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814 & ASTM E 84).

B. Threaded, Smooth and Split-Sleeve Firestop Devices: Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number.

C. QuickComm Sleeve: Firestop Sleeve for use in through penetration firestop systems. Shall be tested by Underwriters Laboratories Inc. or a recognized Testing Laboratory for through penetration fire stopping applications.

D. QuickComm Unit: Intumescent Firestopping Unit for use in large openings for firestopping for cables, Fiber optic, Power Control, Telecommunications
1. Threaded Firestop System
   a. Block Wall - W-J-3049
   b. Dry Wall - W-L-3138
2. Threaded Firestop System (Vertical)
   a. Slab - F-A-3010
3. Smooth Firestop System
   a. Block Wall - W-J-3048
   b. Dry Wall - W-L-3137
4. Split-Sleeve Firestop System

a. Block Wall - W-J-3047
b. Dry Wall - W-L-3136

5. Tremco QuickComm Sleeve
   a. Block Wall- C-AJ-0123, C-AJ-2580, C-AJ-3270
   b. Dry Wall- WL-0025, WL-2418, WL-3318
   c. Concrete Floor- C-AJ-0123, C-AJ-2580, C-AJ-3270
   d. Fluted Deck- C-AJ-0123
   e. Hollow Core- C-AJ-0123, C-AJ-2580, C-AJ-3318
6. Tremco QuickComm Unit
   a. Dry Wall- WL-3319, WL-4070
   b. Concrete Floor- F-A-3035, F-A-4006

2.04 FIRESTOPPING SYSTEMS

A. Thru-Wall Fitting Firestop System
   1. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls and provide an L rating of less than 5 cfm. The device shall also be tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

B. Threaded, Smooth and Split-Sleeve Firestop Systems
   1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 and ASTM E 84 (UL 1479) fire tests in a configuration that is representative of field conditions.
   2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

C. Firestopping materials and systems must be capable of closing or filling through-openings created by the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials.

D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

E. Firestopping sealants must be flexible, allowing for normal pipe movement.

F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

H. Firestopping material shall be installed inside the cavity of the wall as shown by the annular space requirements in the UL Tested System.

PART 3 – EXECUTION

3.01 CONDITIONS REQUIRING FIRESTOPPING

A. General
   1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.

B. Through-Penetrations
   1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations
   1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet ASTM E 814 and ASTM E 84 Test requirements.

D. Smoke-Stopping
   1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved for the ASTM E 136 Standards.

3.02 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify that environmental conditions are safe and suitable for installation of firestop products.

C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.03 INSTALLATION

A. General
   1. Through Penetration firestop submittals showing each UL Rated Assembly shall be located in the general Contractor's trailer for Inspection purposes.
   2. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Written documentation stating training done on the specific project shall be supplied to the General Contractor for inspection purposes. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
   3. Apply firestops in accordance with UL Tested Systems, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
   4. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
   5. Seal holes and penetrations to ensure an effective smoke seal. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
      a. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
      b. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction
   1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.04 FIELD QUALITY CONTROL

A. Preconstruction meeting shall take place to address firestopping systems to be installed.

B. Prepare and install firestopping systems in accordance with UL Tested System and manufacturer's printed instructions and recommendations.

C. Follow safety procedures recommended in the Material Safety Data Sheets.

D. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.

E. All areas of work must be accessible until inspection by the applicable Code Authorities.

F. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.05 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

B. Leave finished work in a neat and clean condition with no evidence of spillovers or damage to adjacent surfaces.

END OF SECTION

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SECTION 26 0533
CONDUIT AND RACEWAYS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. This section covers the complete interior and exterior conduit system.

B. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 STANDARDS

A. Industry Standards
1. Underwriters Laboratories Inc. (UL) Publications
No. 1: Standard for Flexible Metal Conduit
No. 6: Standard for Rigid Metal Conduit
No. 467: Standard for Grounding and Bonding Equipment
No. 651: Standard for Schedule 40 and 80 Rigid PVC Conduit
No. 797: Electrical Metallic Tubing - Steel
No. 1242: Standard for Electrical Intermediate Metal Conduit - Steel
2. American National Standards Institute (ANSI)
C-80.1: Rigid Galvanized Conduit
C-80.3: Electrical Metallic Tubing

1.03 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conduits and raceways, complete, as indicated on the Drawings and as specified herein.

B. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers
1. Metallic Conduit Fittings
a. Thomas and Betts
b. Appleton
c. RACO
d. Crouse Hinds
e. Steel City
2. Support Channel
a. Unistrut
b. Kindorf
3. Non-metallic Conduit Fittings
a. Carlon
b. Georgia Pipe Company
4. Rigid, IMC or Flexible Conduit
a. Allied
b. Republic

c. Triangle
d. Wheatland
e. Youngstown
f. Southwire

5. Flexible Conduit (PVC Conduit)
   a. Anaconda “Sealtite”
   b. Robroy
   c. Southwire
6. Electrical Metallic Tubing
   a. Steeltubes
   b. National
   c. Wheatland
   d. Allied
   e. Triangle
   f. Youngstown
7. Plastic PVC
   a. Carlon
   b. Georgia Pipe Company
8. Pull Box Manufacturer(s)
   a. Hoffman
   b. OZ Gedney
   c. Or Approved Equal
9. Approved Marker Tape Manufacturer(s)
   a. William Frick & Associates
   b. Or Approved Equal
10. Approved Maintenance Hole/Handhole Manufacturer(s)
    a. Old Castle
    b. Pencell (Handholes Only)
    c. Quazite (Handholes Only)
    d. Or Approved Equal
11. Approved Conduit Plug/Cap Manufacturer(s)
    a. Jack Moon
    b. Or Approved Equal

2.02 CONDUIT FITTINGS

A. Electrical metallic tubing (EMT) couplings and connectors shall be steel. Malleable iron, pressure cast or die cast fittings are not permitted.

B. Fittings and couplings shall be set-screw type and/or compression type per 3.1 13. Steel set screw type for 2.5" conduit and larger shall have 2 screws for connectors and 4 screws for couplings. All connectors shall be insulated throat type.

C. Rigid steel and IMC couplings and connectors shall be standard threaded couplings, locknuts, bushings and elbows. All materials shall be steel. Erickson-type couplings may be used to complete a conduit run.

2.03 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be heavy wall, Schedule 40 PVC.

B. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. PVC conduit for concrete encasement shall be Type DB, UL Labeled for 90 degrees C cables. Fittings shall be Type DB, solvent type, and from the same manufacturer as the conduit.

D. Concrete shall have a minimum strength of 2,500 psi at 28 days.

2.04 CONDUIT SUPPORT

A. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2" and smaller with 1/4" threaded steel rods and use 3/8" rods for 2" and larger.

B. Conduit support channels shall be 14-gauge galvanized (or equivalent treatment) channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Conduit straps shall be spring steel type compatible with channel.

C. Conduit straps shall be single-hole cast metal type or two-hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

D. Conduit run on roof shall be supported at intervals not exceeding 10 feet using supports by Dura-blok db10, or equal.

2.05 RIGID METALLIC CONDUIT, INTERMEDIATE METALLIC CONDUIT, AND ELECTRICAL METALLIC TUBING

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Electrical metallic tubing (EMT) shall be steel.

2.06 RIGID METALLIC, INTERMEDIATE METALLIC, AND FLEXIBLE CONDUIT AND FITTINGS

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Flexible conduit shall be steel or aluminum type classified for system grounding.

C. Connectors for flexible conduit shall be insulated throat type rated as suitable for system ground continuity.

D. Flexible conduit used for other than connections to lighting fixtures shall not be less than 1/2" trade size. 3/8" flexible conduit may be used for connection to lighting fixtures when sized according to the National Electrical Code.

E. Flexible conduit used in damp or wet locations shall be liquid tight.

2.07 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.08 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes
1. Maintenance holes shall be pre-cast or cast in place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
3. Maintenance holes shall be equipped with grounding busbar.
4. Maintenance holes shall be equipped with racking for cable storage.

5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.
6. The cover for electrical maintenance holes shall have the lettering, “POWER” or “ELECTRIC.”
7. The cover for low voltage maintenance holes shall have the lettering, “COMMUNICATIONS.”

B. Handholes
1. Handholes shall be non-conductive and shall not require grounding for safety. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
2. Handholes shall be equipped with racking for cable storage.
3. Electrical handholes shall have the word “POWER” or “ELECTRIC” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
4. Low voltage handholes shall have the word “COMMUNICATIONS” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
5. Handholes shall be able to withstand 10,000 lbs minimum.
6. See Drawings for handhole dimensions and locations.

2.09 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps
1. Conduit plugs shall provide a watertight seal at expose ends of conduits.
2. Conduit plugs shall be conduit size specific.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General
1. Minimum size for electrical conduits shall be 1/2" trade size.
2. Minimum size for low voltage conduits shall be 3/4" trade size.
3. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the drawings.
4. Leave all empty conduits with a 200 pound test nylon cord pull line.
5. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
7. Protect conduits against dirt, plaster, and foreign debris with conduit caps or plugs, which shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage, any damage conduits shall not be used and are to be replaced.
8. All feeder conduits shall be cleared of any dirt, foreign debris, etc.
9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a Contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
10. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer’s recommendations and architectural specifications.

11. Seal all conduits entering building from below grade, all conduits entering refrigerated spaces i.e. freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture.
12. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeders cables, unless indicated otherwise on the drawings.
13. Conduit fittings shall be set screw type for dry, indoor environments. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments or wet locations.
14. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members.
15. Support conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, fitting, panelboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
16. Attach feeder conduits larger than one inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
17. Where conduits must pass through structural members obtain approval of Architect.
18. Install all conduits or sleeves penetrating or routed within rated fire walls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
19. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
20. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
21. Telephone and signal system raceways: 2" trade size and smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

B. Uses Permitted

1. Conduits installed within concrete floor slabs shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC), Schedule 40, heavy wall PVC, or electrical non-metallic tubing (ENT).
2. Conduit run exterior exposed: Galvanized rigid steel (GRS) or intermediate metal conduit (IMC).
3. Conduits in direct contact with earth shall be Schedule 40, heavy wall PVC. Elbows for underground conduits greater than 200' in length shall be galvanized rigid steel (GRS), or electrical metallic tubing (EMT) if elbows are concrete encased. Service entrance conduits installed exposed, or concealed in walls or above ceilings, shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Unless indicated otherwise, service entrance conduits shall be installed “outside” of the building as defined by the NEC. Provide concrete encasement where required or as indicated on drawings.
4. All other conduit, unless specified herein, not permitted in accordance with the NEC, or otherwise indicated on the drawings, shall be electrical metallic tubing

(EMT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete or below grade. Feeder or branch circuit conduits that emerge from a floor slab in an exposed location shall be galvanized rigid steel (GRS), electrical metallic tubing (EMT) or intermediate metal conduit (IMC). Where conduits emerge from a floor slab in a concealed location (a wall cavity or above ceiling), PVC elbows are permitted, provided that a conduit adaptor for steel conduit is installed at the nearest point at the slab.

5. Use flexible conduit for connections to motors, dry type transformers, electrical duct heaters, unit heaters, bus duct tap devices, flush mounted lighting fixtures, and any vibrating equipment.
   a. Flexible conduit used for connection of motors, dry type transformers, electric duct heaters, unit heaters, and bus duct tap devices shall not exceed 36 inches in length.
   b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.
   c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
   d. Flexible conduit installed within plenum spaces shall be limited to lengths not exceeding 4 feet.
   e. Liquid tight flexible conduit shall be used to connect equipment in exterior, damp or wet locations.
6. All conduit from the fire pump controller to the fire pump shall be either galvanized rigid steel (GRS) or liquid tight flexible conduit.

C. Below Grade Raceway Installations
   1. Install top of conduits 2 inches minimum below bottom of building slabs.

D. Raceway Installations within Concrete
   1. Conduit shall be run following the most direct route between points.
   2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
   3. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduit shall not be run directly below and parallel with load bearing walls.
   4. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
   5. Provide expansion fittings in all conduits that pass through building expansion joints.

3.02 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

3.03 MAINTENANCE HOLES/HANDHOLES

A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.

B. Tops of maintenance holes/handholes shall be level with the existing grade.

C. Ducts should enter as perpendicular to the wall surface as possible.

D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods

and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.04 CONDUIT PLUGS/CAPS

A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.

B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

3.05 ADDITIONAL REQUIREMENTS FOR INTERIOR LOW VOLTAGE CONDUITS

A. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

B. Communications conduit system shall contain no condulets (also known as an LB).

C. Horizontal Conduits

1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
2. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
3. Each horizontal home-run conduit can serve from one (1) to three (3) outlet boxes. For one (1) outlet box, a 3/4" conduit shall be used, minimum. For two (2) outlet boxes, a 1" conduit shall be used, minimum. For three (3) outlet boxes, a 1-1/4" conduit shall be used, minimum.

3.06 REQUIREMENTS FOR OUTSIDE PLANT LOW VOLTAGE CONDUITS

A. Duct Banks

1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes/handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
2. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
3. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
4. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.
5. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
6. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
7. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.

8. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
9. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
10. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
11. Ducts shall be identified in the maintenance holes and at both ends.

B. Additional OSP Conduit Requirements
1. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
2. Below Grade Conduit Installations
   a. Install top of conduits 24 inches minimum below finished grade.
   b. Install top of conduits 6 inches minimum below bottom of building slabs.
3. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.

END OF SECTION

SECTION 26 0534
OUTLET BOXES AND JUNCTION BOXES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install outlet and junction boxes, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made the Contractor shall be responsible for the costs of any item and engineered and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.03 QUALITY ASSURANCE

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

1.04 JOB CONDITIONS

A. Protection: Anchor boxes securely to formwork. Provide necessary protection to prevent entry of concrete.

B. Sequencing, Scheduling: Locations of outlets shown on the Drawings are relative and approximate. Exact locations shall be determined on the job and the outlets accurately set according to the architectural drawings, dimensions, casework kneespace, building conditions, furniture positions and Architect's direction. The right is reserved to change the exact location (10'-0" or less) of any switch, ceiling outlet or other outlet in any room before it is permanently installed without increase in Contract cost.

C. All outlet boxes and junction boxes shall be accessible. Any boxes in non-accessible areas (furred ceilings) shall be set flush with barrier surface at a location approved by the Architect.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: National Electric Products Company, Thomas & Betts/Steel City, Appleton or Raco.

2.02 OUTLET BOXES

A. Standard Outlet Boxes: Boxes and covers shall be galvanized steel not less than 1/16" thick and in every instance, of such form and dimensions as to be adapted to its specific use and location, kind of fixtures to be used and number, size and arrangement of conduits connecting thereto and particularly sized to accommodate the number and size of wires to be contained therein.

B. Ceiling outlet boxes shall be 1-1/2" or 3-3/8" deep, 4" octagonal (or 4" square when required due to number of wires). Plaster rings or device covers need not be provided on ceiling boxes. Provide extension rings on ceiling boxes to accommodate number of conductors in box.

C. Wall outlet boxes for toggle switches and convenience outlets shall be 1-1/2" or 2-1/8" deep, 4" or 4-11/16" square. Provide with single-device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

D. Outlet boxes for telecommunication purposes (telephone, data, etc.) shall be 4" x 4" square, 2-1/8" deep. Provide with single device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

E. Junction boxes shall be as specified for ceiling and wall outlet boxes. Provide flat covers on ceiling outlets to match ceiling finish. Provide blank device type coverplates on wall outlets, of same materials as specified for device coverplates in same room or area.

F. Outlet boxes where exposed rigid conduit is used shall be cast ferrous alloy, galvanized or cast aluminum.

G. Covers: Where outlet boxes are to be capped, blank coverplates shall be used.

H. Barriers: Provide barriers between devices operating at different voltages or on separate systems such as normal, critical, or life safety.

2.03 FLOOR BOXES

A. Product Description
1. Floor boxes for receptacles and telephone/data outlets shall be rectangular, non-metallic PVC. Boxes shall be suitable for use in slab-on-grade or above grade. Boxes shall include a non-metallic concrete cover to prohibit concrete or debris from entering the box during installation.
2. Provide number of compartments as indicated on drawings.
3. Coverplates and flanges shall be brass.
4. Floor box device covers shall meet UL 514C requirements for scrubwater test standards.

B. Manufacturer
1. Hubbell PFBRG Series

2. Walker/Wiremold 880MP Series
3. Thomas & Betts 640P Series

C. For poke-thru devices, refer to 2.4 D of Section 26 2726 - Wiring Devices.

2.04 PULL AND JUNCTION BOXES

A. Pull and Junction boxes are not completely indicated. They shall be sized and installed where required in accordance with the NEC.

B. Pull and Junction boxes shall be the suitable NEMA type number to match the environmental conditions.

C. Locations of concealed pull and junction boxes shall be indicated on the record as built drawings for Owner's record.

2.05 CABINETS, FITTINGS, BOXES: GENERAL

A. Cabinets shall be in accordance with UL 50, "Electrical Cabinets and Boxes" and NEMA 250, Type 1. Electrical cabinets, boxes and fittings shall be as required for types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

B. Construction shall be sheet steel, NEMA 1 class except as otherwise indicated. Cabinets shall consist of a box and a front consisting of a 1-piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24" apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24" apart and not over 6" from top and bottom of door. For flush cabinets, make the front approximately 3/4" larger than the box all around. For surface mounted cabinets make from same height and width as box. Furnish metal barriers to separate wiring of different systems and voltage, and furnish accessory feet where required for freestanding equipment.

C. Fasteners for general use shall be corrosion resistant screws and hardware including cadmium and zinc plated items.

D. Fasteners for damp and wet locations shall be stainless steel screws and hardware.

E. Exterior finish shall be gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted interior finish, where indicated, shall be white baked enamel.

G. Fittings for boxes, cabinets, and enclosures shall be in accordance with UL 5148 and shall be zinc plated steel for conduit hubs, bushings and box connectors.

2.06 UNDERGROUND PULL/JUNCTION BOXES

A. Unless noted otherwise, underground enclosures shall be fiberglass, open-bottom and sloped-wall. Covers shall be polymer concrete. Boxes shall be installed in areas expected to experience only light incidental, non-deliberate vehicular traffic (including that from mowers).

B. Enclosures shall meet the load requirements and three-point test procedures specified in the industry standard ANSI SCTE 77 2007. Enclosures shall meet the Tier 8 cover load test (for light traffic) of 12,000 lbs. over a 10" x 10" plate.

C. Manufacturer's guidelines shall be followed for installation, including 6" gravel bed beneath box for stability and drainage. Concrete collar shall be poured around enclosure to protect the ring and top from impact due to soil erosion.

D. Manufacturer
   1. Highline Products
   2. OZ-Gedney

PART 3 – EXECUTION

3.01 INSPECTION

A. The location of all wall outlets, including light fixtures, receptacles, switches, etc., shall be checked to see that the outlet will clear any wall fixture, shelving, work tables, sinks, baseboard and fin type convectors, bulletin boards, etc., that will be installed.

B. Exact locations of outlet boxes shall be coordinated with other trades so that outlet will not be covered by ductwork, piping, etc.

C. The approximate locations of outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

3.02 PREPARATION

A. Architectural Placement: Outlets occurring in architectural features shall be accurately centered in same. Space wall switch outlets equidistant from door trims on the strike side of doors as actually installed so that coverplate clears trim. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on architectural elevations.

B. Install all outlet boxes in finished areas flush with wall or ceiling finish. Maintain 1/4" or less space between outlet box front and finish wall surface.

C. All switches at same level shall be installed on one horizontal line as shown on the Drawings.

D. Wall mounted controls, including temperature controls, in a room shall be grouped at the same location and at same mounting heights.

3.03 INSTALLATION

A. At all concealed outlets for electric lights, switches, wall receptacles, etc., standard outlet boxes and plaster rings shall be provided.

B. Outlet boxes shall be firmly anchored in place and shall be provided with approved fixture studs where required. Outlet boxes shall not depend on the coverplate to hold it secure to the wall.

C. Boxes on opposite sides of walls or partitions: Where drawings show back-to-back wiring devices, the devices on opposite sides of the wall shall be offset a minimum of 6". Through-the-wall type boxes shall not be used. Where boxes will be located on opposite sides of walls or partitions located 24" or closer to each other, moldable putty pads shall be installed to completely cover the exterior surfaces of the box within the stud cavity with a ball of putty material used to plug the end of each conduit at its connection to the box.

D. All holes cut through new or existing smoke or fire partitions shall be sealed. Sealant shall be 3M Brand Fire Barrier System or approved equal. Seals shall be installed in accordance with manufacturer's recommendations.

E. All flush boxes in rated walls that are larger than 16 square inches in area shall be backed as follows: 1-hour wall - 1 layer of 5/8" gypsum board; 2-hour rated wall - 2

layers of 5/8" gypsum board. Gypsum shall be fire code and attached to outside surfaces of box(es).

F. Cast aluminum, threaded hub type boxes with gasketed weatherproof covers shall be used for wet locations where box is surface mounted.

G. Location of floor boxes indicated is approximate. The Contractor shall refer to the final furniture layout or request field instructions for the exact location. Consult the Architect prior to installation.

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SECTION 26 0535
LOW VOLTAGE BACKBOARDS & ENCLOSURES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Section 26 0000 - Electrical General shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to backboards.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and/or on the Drawings.

1.02 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install all backboards.

PART 2 – PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Backboard Manufacturer(s)
   1. Hoover – ¾" Pyro-Guard
   2. Standard ¾" Plywood (treated with fire-retardant paint)

PART 3 – EXECUTION

3.01 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

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SECTION 26 0923
OCCUPANCY SENSORS

PART 1 – GENERAL

1.01 OCCUPANCY DETECTION TECHNOLOGY REQUIREMENTS

A. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

B. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

C. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.

D. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

E. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

1.02 OCCUPANCY SENSOR OPERATION REQUIREMENTS

A. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period. This timer shall be in addition to the regular occupancy time delay that keeps lights on after last detected occupancy. User shall be able to disable/enable and change the value of this timer.

B. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 10 minutes. Sensors with a longer factory default setting shall not be permitted as they greatly restrict energy savings potential.

C. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated, but shall not be allowed unless a calculation showing the resulting energy savings loss is presented to the building owner and specifying engineer.

D. Automatic adjustments to the occupancy time delay shall only be permitted if the controlling algorithm maximizes both lamp life and energy savings. For example a shorter more energy saving time delay setting shall only be allowed if the resulting lamp life is also improved.

E. Installer, in accordance with manufacturer's recommendation, shall determine final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens, and shall not require initial or subsequent field adjustment of detection sensitivity.

F. All sensor setting adjustments shall be digital and made using a push-button. Dip switches, analog dials, and/or the need for tools of any kind shall not be accepted.

G. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.03 MISC REQUIREMENTS

A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing. Manufacturing facility must be ROHS compliant.

B. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

C. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

D. Sensors shall have a 5 year warranty.

1.04 APPROVED MANUFACTURER AND SUBSTITUTIONS

A. Approved manufacturer shall be Sensor Switch, Inc. (800) 727-7483 www.sensorswitch.com.

B. Substitutions must be submitted no less than 5 days prior to bid date. An AutoCAD drawing of the facility showing coverage patterns and technical data must be provided with substitution request. All substitutions must clearly identify any and all exceptions to the specifications with a detailed explanation as to the exception. If substitution is approved, the contractor shall bear the responsibility of a fully functional system to the owner's and specifying engineer/architect's satisfaction.

PART 2 – PRODUCTS

2.01 WALL SWITCH OCCUPANCY SENSORS – SMALL AREAS

A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 20 ft (6.10 m).

B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, *Occupancy Sensor Technology Requirements).*

C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.

D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.

E. Sensor shall recess into single gang switch box and fit a standard GFI opening.

F. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.

G. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

H. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology (only exception is versions with lighted push-buttons).

I. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (off) condition. Sensor shall not require a minimum load to be connected in order to function.

J. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation.

K. All sensor settings, including time delay and photocell settings shall be digital and accessible for adjustment via a push-button without requiring removal of cover plate or tools of any kind.

L. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.

M. All models shall be capable of both Auto-On and Manual On operation.

N. All models shall be capable of a “Reduced Turn On” operation where the initial PIR turn on level is higher in order to eliminate PIR from reflective surfaces from being detected. PIR shall be returned to normal levels upon initial PIR detection.

O. All models shall have a “Predictive Off” mode where user can manually turn the lights off when leaving the room and still have them come on automatically when they return to space.

P. All models shall be capable of disabling override switch.

Q. Sensor shall be the following Sensor Switch model numbers. Device color and optional features as specified on individual datasheet.
1. **WSD** (PIR)
2. **WSD 2P** (PIR, Dual Relays, Auto On Pole 1/Manual On Pole 2)
3. **WSD PDT** (PIR/Microphonics)
4. **WSD PDT 2P** (PIR/Microphonics, Dual Relays, On Pole 1/Manual On Pole 2)
5. **WSD SA** (PIR, Manual On by default)
6. **WSD PDT SA** (PIR/Microphonics, Manual On by default)
7. **WSD NL** (PIR, lighted push-button, neutral required)
8. **WSD PDT NL** (PIR/Microphonics, lighted push-button, neutral required)
9. **WSD LV** (PIR, low voltage, power pack required)
10. **WSD PDT LV** (PIR/Microphonics, low voltage, power pack required)

2.02 WALL SWITCH OCCUPANCY SENSORS – LARGE AREAS

A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 40 ft (12.19 m).

B. In areas with periodic or permanent obstruction to a sensor’s field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, *Occupancy Sensor Technology Requirements).*

C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.

D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz. A version capable of switching 347 VAC shall also be available. Load ratings shall be 13A each pole, ¼ HP motor load.

E. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.

F. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

G. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.

H. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (Off) condition. Sensor shall not require a minimum load to be connected in order to function.

I. Sensor shall be the following Sensor Switch model numbers. Device color and optional features as specified.
   1. **LWS(H)** (PIR)
   2. **LWS(H) 2P** (PIR, Dual Relays)
   3. **LWS(H) PDT** (PIR/Microphonics)
   4. **LWS(H) PDT 2P** (PIR/Microphonics, Dual Relays)

2.03 LOW VOLTAGE OCCUPANCY SENSORS

A. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.

B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, *Occupancy Sensor Technology Requirements).*

C. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.

D. Sensors shall interconnect with other sensors and power/relay packs with class 2, three-conductor wire.

E. Sensors shall operate on 12 to 24 VAC or VDC and consume no more than 5 mA so that up to 14 sensors may be connected to a single power pack.

F. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.

G. Each designated zone shall contain one sensor with a SPDT class 2 auxiliary relay, providing an input to building automation system (BAS). All sensors in designated zone shall communicate to sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that power pack must be installed on the Line side of the local toggle switch for auxiliary relay to work properly.

H. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.

I. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.

J. Sensors shall be the following Sensor Switch model numbers.
   1. **CM 9** (PIR, Ceiling Mount, Standard Range)
   2. **CM PDT 9** (PIR/Microphonics, Ceiling Mount, Standard Range)
   3. **CM 10** (PIR, Ceiling Mount, Extended Range)
   4. **CM PDT 10** (PIR/Microphonics, Ceiling Mount, Extended Range)
   5. **WV 16** (PIR, Corner Mount, Wide View)
   6. **WV PDT 16** (PIR/Microphonics, Corner Mount, Wide View)
   7. **HW13** (PIR, Wall Mount, Hallway View)
   8. **HM 10** (PIR, Surface Mount Box, High Bay Aisle Way)

9. **CM 6** (PIR, Ceiling Mount, High Bay 360°)

K. Sensors with a recessed profile are acceptable substitutes for above ceiling mount sensors (e.g. **CM 9** => **RM 9**)

L. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. **CM 9** => **CMB 9)**

2.04 POWER PACKS

A. Power packs shall accept and switch 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.

B. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

C. When required by local code, power pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

D. Power pack shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for 400,000 cycles.

E. Power packs shall be single circuit, or two circuits. Slave packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.

F. Power packs shall be the following Sensor Switch model numbers.
   1. **PP20** (Single Pole)
   2. **PP20 2P** (Two Pole)
   3. **SP20** (Slave Pack)

2.05 LINE VOLTAGE OCCUPANCY SENSORS

A. Sensors shall be self-contained and accept Class 1 wiring directly without the use of a power pack.

B. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.

C. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, *Occupancy Sensor Technology Requirements).*

D. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.

E. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

F. Multiple sensors controlling the same load shall be wired in parallel.

G. For applications requiring independent control of two loads, a sensor with two dual relays shall be required. Each relay shall have independent programmable occupancy time delays.

H. Dual relay sensors shall have an optional operational mode called “Alternating On” where when during unoccupied periods, one relay is always left closed (thus one load is always on). The particular relay that is left closed alternates each cycle so that the aging of the connected lamps is even.

I. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.

J. Specific sensors capable of switching 5 Amps of two phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.

K. Wall mounted sensors must be installed at 7 to 8 feet above the floor. Single and two circuit units shall be available.

L. High bay sensors controlling HID Bi-Level must incorporate a “Start to High” timer on initial power up to provide full light output for up to 20 minutes to prevent shortened lamp life.

M. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.

N. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.

O. Sensors shall be the following Sensor Switch model numbers.
1. **CMR 9 / CMR 9 2P** (Standard Range 360°, PIR, Ceiling Mount – Single / Two Pole)
2. **CMR PDT 9 / CMR PDT 2P** (Standard Range 360°, PIR/Microphonics Dual Technology, Ceiling Mount – Single / Two Pole)
3. **CMR 10 / CMR 10 2P** (Extended Range 360°, PIR, Ceiling Mount – Single / Two Pole)
4. **CMR PDT 10 / CMR PDT 10 2P** (Extended Range 360°, PIR/Microphonics Dual Technology, Ceiling Mount – Single / Two Pole)
5. **CMRB 10 / CMRB 10 2P** (Extended Range 360°, PIR, Fixture Mount Box – Single / Two Pole)
6. **CMRB PDT 10 / CMRB PDT 10 2P** (Extended Range 360°, PIR/Microphonics Dual Technology, Fixture Mount Box – Single / Two Pole)
7. **WVR 16 / WVR 16 2P** (Wide View, PIR, Wall Mount – Single / Two Pole)
8. **WVR PDT 16 / WVR PDT 2P** (Wide View, PIR/Microphonics Dual Technology, Wall Mount – Single / Two Pole)
9. **CMR 6 / CMR 6 2P** (High Bay 360°, PIR, Ceiling Mount – Single / Two Pole)
10. **CMRB 6 / CMRB 6 2P** (High Bay 360°, PIR, Fixture Mount Box – Single / Two Pole)
11. **CMRB 50 / CMRB 50 2P** (High Bay Aisleway, PIR, Fixture Mount Box – Single / Two Pole)
12. **HMRB 10** (High Bay End-of-Aisle, PIR, Fixture Mount Box)

P. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors (e.g. **CMR 9** => **RMR 9**)

2.06 INDOOR PHOTOCELLS AND DAYLIGHT HARVESTING CONTROLS

A. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.

B. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

C. Photocell set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Further adjustment may be made manually if needed.

D. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

E. Low voltage dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).

F. Low voltage dimming sensor's set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

G. Low voltage dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

H. Combination photocell/dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the on/off function as well as the dimming function of 0 to 10 VDC dimmable ballasts.

I. Combination photocell/dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set point may be manually entered.

J. Combination photocell/dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

K. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.

L. Stand-alone ambient light sensors (CM ALC version only) shall interface directly with the 0 to 10 VDC, without any other power source connection, and control dimmable ballasts by sinking up to 20 milliamps of class 2 current. Sensor shall incorporate a photodiode viewing out of a ceiling enclosure at a 30 degree angle from horizontal to detect diffused light from the ambient and artificial sources. Sensor shall allow for removal of response delays for adjustment, however provide dampening delay for normal operation. Settings shall be made manually.

M. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.

N. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC.

O. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 5 Amps of two phase power (208/240 or 480 VAC)

shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.

P. Sensors shall be the following Sensor Switch model numbers.
1. **CM P**C (Photocell, On/Off, Low Voltage, Ceiling Mount)
2. **CM ADC** (Dimming Photocell, Low Voltage, Ceiling Mount)
3. **CM PC ADC** (Combination Photocell/Dimming Sensor, Low Voltage, Ceiling Mount)
4. **CM PC DZ, CM ADC DZ, or CM PC ADC DZ** (Dual Zone, Low Voltage)
5. **CM ALC** (Stand Alone Ambient Light Sensor for Daylight Harvesting)
6. **CMR P**C (Photocell, On/Off, Line Voltage, Ceiling Mount)
7. **CMR ADC** (Dimming Photocell, Line Voltage, Ceiling Mount)
8. **CMR PC ADC** (Combination Photocell/Dimming Sensor, Line Voltage, Ceiling Mount)
9. **CMR PC DZ, CMR ADC DZ** (Dual Zone, Line Voltage)

Q. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors (e.g. **CMR PC** => **RMR PC**)

R. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. **CMR PC** => **CMRB PC**)

PART 3 – EXECUTION

3.01 INSTALLATION

A. It shall be the Contractor's responsibility to locate and aim sensory 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 have 90 to 100% coverage to 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.

B. It is the Contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

C. 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.

3.02 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

B. The electrical contractor shall provide both the manufacturer and the Electrical Engineer with ten (10) working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide training to the Owner's personnel in the adjustment and maintenance of the sensors.

END OF SECTION

SECTION 26 0943
LIGHTING CONTROL SYSTEM – RELAY PANELS

PART 1 – GENERAL

1.01 INTRODUCTION

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. The Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.02 SYSTEM DESCRIPTION

A. Install a low voltage switching system consisting of relay panels and intelligent switches connected together by a dataline, as well as all associated wiring.

B. The system includes a DIN rail-mounted automation module, photocontrol module and/or other low voltage control devices. These devices are totally compatible with the manual operation of the dataline switches.

C. Requirements are indicated elsewhere in the specifications for work including, but not limited to, raceways and electrical boxes and fitting required for installation of control equipment and wiring.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall be ISO 9001 certified.

B. Component Pre-testing: All components and assemblies are to be factory pre-tested prior to installation.

C. System Support: Factory applications engineers shall be available for telephone support.

D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.

E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL Approvals: Remote panels are to be UL Listed under UL 916 Energy Management Equipment.

G. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

1.04 SUBMITTALS

A. Shop Drawings: Submit dimensional drawings of all lighting control system components and accessories.

B. One-Line Diagram: Submit a one-line diagram of the system devices and cabling.

C. Typical Wiring Diagrams: Submit typical wiring diagrams for all components including, but not limited to, relay panels, relays, low voltage dataline switches, occupancy sensors and daylighting controls.

1.05 MANUFACTURERS

A. Acceptable manufacturers for lighting control system are Watt Stopper Lighting Control & Design, Leviton, Lutron and Square D Clipsal.

PART 2 - MATERIALS AND COMPONENTS

2.01 SMARTWIRED SWITCHING (SWS) RELAY PANELS

A. Description: Modular Relay Panels shall be UL Listed and consist of the following:
   1. Tub: Empty NEMA 1 enclosure that can accept an interior sized to accept up to 12, 24, or 48 mechanically latching relays.
   2. Power Supply: As required
   3. Cover: Surface or flush as required, with captive screws in a hinged, lockable configuration.
   4. Interior: Interiors shall be provided with up to 12, 24, or 48 installed and tested relays as shown on the Drawings.
   5. Panel shall be provided with provisions for additional components, data connections, etc.

B. Features
   1. Relays shall be momentary-pulsed mechanically latching contactors with plug in connector. Relays shall have mechanically latching contacts with single moving part design for improved reliability. Relays will have the following characteristics:
      a. Coil
         1) Magnetically held, momentary coil activation (50 milliseconds).
         2) 2.2 VA max per relay to allow up to 20 relays to be controlled in parallel using class 2 wiring.
      b. Power Contacts
         1) 20 amp tungsten and NEMA electronic ballast rated.
         2) Rated for 50,000 ON/OFF cycles at full load.
         3) Support #10 - #14 WG solid or stranded wire.
         4) 120, 277 and 347 volt rated.
         5) Standard 1 year warranty.
      c. 30 VAC isolated contacts for status feedback and pilot light indication.
      d. FCC approved for commercial and residential use.
   2. Next to each relay shall be an individual override button and a bi-color LED to indicate status.
   3. Panels shall support the “blink warning” function, with LED indication for each relay.
   4. Captive screw terminations will be provided for all wiring connections.
   5. Each channel button’s dry control contact input terminal shall accept either 2 or 3-wire, maintained or momentary inputs. They shall also accept a 2-wire toggling input.
   6. Each channel shall also have an associated 1 amp, 30 VDC isolated contact which may be used for status feedback or pilot light control.
   7. The unit shall provide LED status indication of the power supply status. Access to 24VAC and 24V rectified power for accessory devices shall be provided within the panel.
   8. The panel shall have an integrated DIN rail for mounting dataline control modules.

2.02 NETWORK DATALINE

A. Description
   1. The intelligence in multiple panels shall be linked over a single dataline.

2. The dataline, in addition to linking together multiple relay panels, shall be capable of extending out from the electrical closet, and provide a single communications bus to allow dataline switches to communicate with the panels.
3. The dataline can also connect to a single network clock or a single BMS interface module mounted in the interior of a relay panel or a separate enclosure.

B. Features
1. Dataline shall be 18 AWG, 4 unshielded copper conductors (two independent twisted pairs) meeting Class 2P NEC code requirements. The dataline can be run in a loop, serial, or star configuration. Minimum 1 turn per 3 inches; capacitance 30pF/foot max.
2. Maximum length for all dataline wire in the system is 1,500 feet without repeaters.
3. Maximum number of dataline devices (panels/switch units/controllers) is 64 without a repeater.

2.03 IDENTIFICATION

A. Description
1. To allow individual overrides, dataline switches shall be terminated to each panel's 4-wire local dataline. Switches shall be available in single, dual, quad, or octal (1-button, 2-button, 4-button, or 8-button) designs. The single, dual, and quad devices shall mount in a standard single gang box; the octal version in a two-gang box.
2. Each button in a switch module can be individually programmed. Each button can control any one of the following options:
   a. Any individual relay in any single panel.
   b. Any group of relays in any single panel.
3. For special applications see Drawing notes.

B. Features
1. Provide switches as shown on the Drawings for overrides, and programmed for specific applications such as
   a. Blink notice
   b. Cleaning Scenario
   c. Parallel operation
2. Back Lit LEDs as required

2.04 NETWORK CLOCK

A. Description
1. Provide a network clock. Network clock can be used to schedule timed scenarios vs. digital input signals.
2. Astronomical type time clock to be included.

2.05 SMARTWIRED PHOTOCONTROL MODULE

A. Description
1. A single photocell shall be mounted in an appropriate location for measuring exterior light levels. The sensor shall connect to a separate photocontrol module via the local dataline, which provides power to the unit. No extra wires shall be required.
2. The photocontrol module shall be designed to integrate seamlessly with either the network clock or the BMS interface module.
3. The photocontrol module shall measure the actual exterior light level. Each of the eight global channels shall have the ability to be assigned a different trip level.

2.06 BMS INTERFACE MODULE

A. Description: The BMS interface module shall be used in lieu of the network clock to provide the same lighting control functions (with the exception of the astronomic function),but shall allow an external automation device to provide the signal that changes channel status from “occupied” to “unoccupied” (after-hours).

B. Features: Automatically detects the presence of the photocontrol module on the dataline and adds the dark scenarios to the menus, accepting actual light level readings for the following scenarios:
   1. Dark ON/Dark OFF
   2. Dark ON/Schedule OFF

2.07 TELEPHONE CONTROL MODULE

A. Description: The telephone control module shall allow building occupants to override the lighting on or off using a touch-tone telephone.

2.08 UNIVERSAL SWITCH INTERFACE MODULE

A. Description: Provide a universal switch interface module to wire non-dataline switches to the SWS network or to accept contact closures from other systems.

2.09 AUTOMATIC CONTROL SWITCH

A. Description
   1. The automatic control switch shall be a line voltage, push-button wall switch capable of ON/OFF manual operation and also of receiving control signals through the temporary interruption of power to the circuit via the relay panel.
   2. Occupants shall have a five-minute time delay to press the switch, keeping the lights on until the end of the next sweep interval.

B. Features
   1. 120 VAC or 277 VAC models with matching wall plate included.
   2. Audible beep during time delay can be enabled or disabled without removing the switch face plate.
   3. Locator LED.

2.10 ACCESSORY ENCLOSURE

A. Description: Provide an Accessory Enclosure with integral DIN rail mounting area and connections for dataline and optional power supply as needed for remote mounting of intelligence modules.

PART 3 - EXECUTION AND SUPPORT SERVICES

3.01 INSTALLATION

A. Dataline switches and/or photocells shall be mounted in the spaces as indicated on the Reflected Ceiling Plans. Each low voltage wire shall be labeled clearly indicating which relay panel it connects to. Use only properly color-coded, stranded #18 AWG (or larger) wire as indicated on the Drawings. All relays and switches shall be tested after installation to confirm proper operation, and all connected loads shall be recorded on the relay schedule for each panel.

B. The relay panels shall be mounted in electrical closets as indicated on the Drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the Drawings. All power wiring will be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel’s designation.

3.02 CONTRACTOR PROVIDED INFORMATION

A. The Contractor shall provide system documentation after the equipment has been installed.
   1. Relay Panels: Panels shall be numbered consecutively beginning at #01 as shown on the Drawings. Individual relay load descriptions and the channels to which they are smartwired shall be recorded on the SWS Relay Schedule form provided with each panel.
   2. Intelligent Dataline Switches: Each intelligent switch on a relay panel's local dataline shall be numbered consecutively beginning with #01. This switch designation shall be recorded on the label provided on the front of the switch unit, under the wall plate. (For example, the switches connected to relay panel #02 would be numbered 02-01, 02-02, 02-03, etc.). The relays (or channels) controlled by each switch shall be recorded on the "SWS Switch Documentation" from provided with the relay panel.
   3. Network Clock (or BMS Interface): The automation scenarios and operating data for each of the eight channels shall be recorded on the "Network Clock Automation Scenarios" form or "BMS Interface Automation Scenarios" form provided with the network clock or BMS interface module.
   4. System installation and operation manual shipped with the network clock or BMS interface module shall be provided to the Owner.

3.03 DOCUMENTATION

A. Manufacturer shall provide system documentation including:
   1. System 1-line showing all panels, number and types of switches and sensors, dataline, and network timeclock of BAS interface unit.
   2. Drawings for each panel showing hardware configuration and numbering.
   3. Panel wiring schedules.
   4. Typical wiring diagrams for each component.

3.04 WARRANTY

A. Manufacturer shall provide a 1-year warranty for all system components.

3.05 SYSTEM STARTUP

A. Manufacturer shall provide a factory authorized to confirm proper installation and operation of all system components.

3.06 TRAINING

A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the lighting control system.

END OF SECTION

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SECTION 26 2200
DRY TYPE TRANSFORMERS

PART 1 – GENERAL

1.01 DESCRIPTION

A. The work required under this section of the Specifications consists of the furnishing, connection and installation of dry type transformers.

1.02 QUALITY ASSURANCE

A. The requirements of the following standards shall become a part of this Specification by reference:
1. Underwriters Laboratories Inc. (UL) Publications:
No. 506, 1561: Transformers (1,000 kVA, 3-phase and below; 167 kVA, 1 phase and below)
2. National Fire Protection Association (NFPA):
No. 70: National Electrical Code (NEC)
3. National Electrical Manufacturers Association (NEMA):
No. St-20: Dry-type transformers for general applications
4. American National Standards Institute (ANSI):
No. C89.2
5. Energy Policy Act of 2005 - Public Law 109-58

B. Acceptable Manufacturers
1. General Electric
2. Square D
3. Siemens
4. Eaton

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications to ensure transformer access, clearance minimums, and adequate ventilation are provided.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENT

A. Furnish all materials specified herein and indicated on the drawings.

B. All transformers shall be UL Listed and bear a UL Label.

2.02 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Insulation System
1. Single-phase 25-167 kVA and 3-phase 30-500 kVA: Transformers shall be rated for average temperature rise by resistance of 150 degrees C in 40 degrees C maximum ambient, 30 degrees C average ambient. Transformer insulation system shall be UL rated as 220 degrees C system.
2. 3-phase 3-15 kVA: Transformers shall be rated for average temperature rise by resistance of 115 degrees C. Insulation system shall be 180 degrees C.
3. All transformers shall have insulation systems of Class 155 or higher.

B. Sound rating shall comply with NEMA and ANSI standards for kVA rating. Internal vibration dampening shall be provided for all transformers.

C. Single-phase transformers rated up to 15 kVA shall have two (2) 5% full capacity taps below normal rated primary voltage. All other single-phase and all 3-phase transformers shall be provided with six (6) 2-1/2% full capacity taps, two (2) above and four (4) below normal voltage, unless only four (4) 2-1/2% taps, two (2) above and two (2) below normal voltage are standard.

D. Construction/Enclosures
   1. Transformers 30-1,500 kVA: Transformer enclosures shall be ventilated and drip-proof with removable front and rear cover panels. Transformers shall be suitable for floor mounting, unless wall mounting is indicated on the drawings.
   2. Transformers up through 25 kVA: Transformer housings shall be totally enclosed, non-ventilated and drip-proof. Access to wiring compartment shall be permitted via removable panel.

E. Energy efficiency of transformers shall meet the minimum standard as outlined in NEMA TP-1 tables.

F. Core assemblies and the center ground point of the coil secondaries shall be grounded to the enclosure by flexible ground straps. Provide grounding lug at the enclosure bonding location for connection of three conductors: the primary and secondary equipment grounding conductors and the grounding electrode conductor.

G. Transformer coils shall consist of aluminum windings.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation shall provide not less than twelve inch clearance from combustible materials and not less than 6" clearance from walls or equipment. Floor-mounted transformers shall be mounted on neoprene, waffle type vibration pads 5/8" thick. Where transformers are mounted on channels angles, transformers shall be bolted to structure with 5/8" thick vibration pad between transformer base and structural channel. 4" thick concrete housekeeping pads shall be used for all floor-mounted transformers.

B. Provide working clearance and full accessibility for transformer as required by the National Electrical Code.

C. Primary and secondary connections to dry type transformers shall be made with flexible conduit.

D. The secondary windings of each dry type transformer shall be grounded in accordance with the National Electrical Code requirements for separately derived electrical systems. Extend a grounding electrode conductor from the transformer grounding lug to the nearest building structural steel and to the nearest available point on the interior water piping system. Connect the primary and secondary feeder, equipment grounding conductors to the grounding lug, also. Refer to the grounding section of these Specifications for additional requirements.

3.02 CLEANING AND ADJUSTMENT

A. Prior to job completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch-up paint scratched surfaces with factory furnished touch-up paint of the same color as the factory applied paint.

END OF SECTION

SECTION 26 2413
SWITCHBOARDS

PART 1 – GENERAL

1.01 DESCRIPTION

A. The work required under this section of the Specifications consists of the installation of all switchboards for use on systems 600 volts and below. All materials and devices which are an integral part of the switchboards shall be provided under this section of the Specifications.

B. Switchboards as specified in these Contract Documents are free standing, dead-front, metal enclosed panels of one or more sections. The overcurrent devices may be individually or group mounted.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers: Products of the following manufacturers, which comply with these Specifications, are acceptable:
   1. Square D
   2. Siemens
   3. Cutler Hammer
   4. ABB - General Electric

B. Equipment Dimensions
   1. Dimensions noted on the Drawings are the maximum allowable and shall not be exceeded. Where switchboard(s) of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

C. Coordination
   1. Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications and electrical equipment to ensure access and so that clearance minimums are provided.

1.03 SUBMITTALS

A. Refer to Section 26 0000 - Electrical General for submittal requirements.

B. Shop Drawings: Submit shop drawings to indicate compliance with the Contract Documents.
   1. Include electrical characteristics and ratings for each switchboard with dimensions, mounting, bus material, voltage, bracing, ampere rating, mains, poles and wire connection, and any accessories.
   2. Include bussing diagram indicating each circuit breaker or fused switch position.
   3. Provide a schedule indicating overcurrent device, trip and size, poles, frame type, fuse size and type, or circuit breaker interrupting capacity.

1.04 SHORT CIRCUIT AND COORDINATION STUDY

A. Contractor shall provide a Short Circuit and Protective Device Study to verify the proposed equipment ratings and protective device ratings. The study shall be performed

by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems.

B. The scope of the study shall include all proposed distribution equipment supplied under this contract.

C. Contractor shall obtain, in writing, the short circuit current value at the main service switchboard for the specific project location from the utility.

D. All service equipment shall be legibly marked in the field with the maximum available fault current and the date the fault current calculation was performed in accordance with NEC 110.24.

E. A copy of the Short Circuit and Protective Device Study shall be included in the shop drawing submittals for the equipment, and made available to those authorized to design, install, inspect, maintain, or operate the system.

1.05 PROTECTIVE DEVICE COORDINATION STUDY

A. Overcurrent protective devices shall be selectively coordinated for distribution systems serving emergency and legally required standby loads, as well as those serving multiple elevators, for faults with durations at 0.01 seconds.

B. Contractor shall provide a protective device coordination study for:

1. Distribution systems required to be selectively coordinated that contain circuit breakers.
2. Distribution systems containing breakers with adjustable trip settings.
3. Distribution systems requiring arc-flash analysis.

C. The study shall be performed by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems.

D. A copy of the Protective Device Coordination Study shall be included in the shop drawing submittals for the equipment, and made available to those authorized to design, install, inspect, maintain, or operate the system.

1.06 ARC FLASH SAFETY

A. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D, and IEEE 1584 – Guide for Performing Arc Flash Hazard Calculations.

B. Arc Flash Hazard Analysis
1. All main switchboards, distribution panels and panelboards are to have an arc flash level of no more than 11.9cal/cm2.
2. Prior to the purchase of equipment, the manufacturer of switchboards and panelboards shall provide an arc flash hazard analysis for the electrical distribution system. Include this study in the shop drawing submittals for the equipment.

3. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
4. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
5. The flash protection boundary and the incident energy shall be calculated and reported at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
6. The arc flash hazard analysis shall include all MV, 575v, and 480v locations and locations in 240 volt and 208 volt systems rated 400 amps and above.
7. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
8. The arc flash hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
9. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
10. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
11. The report shall indicate incident energy and flash protection boundary calculations as follows:
    a. Arcing fault magnitude
    b. Device clearing time
    c. Duration of arc
    d. Arc flash boundary
    e. Working distance
    f. Incident energy
    g. Hazard risk category
    h. Recommendations for arc flash energy reduction

C. Arc Flash Warning Labels
1. Contractor shall field-install arc flash labels on equipment that includes the available incident energy and required personnel protective equipment (PPE).
2. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
3. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD,” and shall include the following information:
    a. Location designation
    b. Nominal voltage
    c. Flash protection boundary
    d. Hazard risk category
    e. Incident energy
    f. Working distance
    g. Engineering report number, revision number and issue date
4. Labels shall be machine-printed, with no field markings.

5. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings:
   a. For each 600, 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided.
   b. For each motor control center, one arc flash label shall be provided.
   c. For each low voltage switchboard, one arc flash label shall be provided.
   d. For each switchgear, one flash label shall be provided.
   e. For medium voltage switches one arc flash label shall be provided.
6. Labels shall be field-installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

D. Arc Flash Training
1. The equipment vendor shall train up to four (4) personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish all materials specified herein.

B. The switchboard, circuit breakers, and fused devices shall be UL Listed and bear the UL Label. Where a switchboard is utilized as service entrance equipment, it shall be UL Labeled as suitable for such use.

C. The switchboard(s) shall be suitable for operation on the voltage system indicated on the Drawings.

2.02 STRUCTURE ARRANGEMENT

A. The switchboard(s) shall consist of free-standing, standardized vertical sections bolted together to form a continuous structure.

B. Adequate space for conduit and conductors entering the top or bottom, in accordance with the National Electrical Code, shall be provided without structural interference, conductors shall be safely accessible without disrupting service.

C. The structure and all components shall be finished in the manufacturer’s standard corrosive-resistant primer and coating.

D. Unless noted otherwise, switchboard sections shall be front accessible.

2.03 BUS ARRANGEMENT

A. All busses shall be copper, rated for a 65 degrees C temperature rise above a 40 degrees C ambient. The minimum bus bracing, in RMS-symmetrical-amperes, shall be as shown on the Drawings. All electrical buss connections shall be made with silicon bronze hardware.

B. A neutral bus bar shall be provided, rated 100% of the main phase bus bar ampacity.

C. The main bus shall be fully rated for the entire length of the switchboard.

D. All non-current-carrying parts of the switchboard shall be grounded through the use of a continuous horizontal ground bus connected to vertical ground busses in each section. Ground bus rating shall meet or exceed the ampacity of the electrical service grounding electrode conductor(s).

E. An accessible cable termination compartment shall be provided for incoming line termination for main lug only applications. Lugs shall be suitable for terminating the size and quantity of conductors as indicated.

F. All terminal lugs shall be UL Labeled for AL or CU conductors rated for 75 degrees C.

2.04 MAIN PROTECTIVE DEVICE(S)

A. The main protective device(s) shall employ fixed type mounting. The devices shall be individually mounted in the switchboard.

B. Provide insulated case circuit breaker(s)

1. Breaker(s) shall be 600V AC, 50/60 HZ rated. The frame and current ratings shall be as indicated on the Drawings.
2. Circuit breaker trip functions shall include adjustments for continuous amperage, long time pickup and delay, instantaneous, and ground-fault pickup and delay. Fault indication shall be provided on the trip unit for overload, short time, short circuit, and ground fault conditions.
3. Breaker(s) must carry a UL 429 Listing, be rated for 100% continuous duty, approved for reverse connection, and shall be stationary mounted, suitable for manual operation. Breaker(s) must carry an individual serial number with factory-maintained production and test records.
4. The breaker operating mechanism shall be a true two-step stored energy mechanism that shall provide a five cycle maximum closing time. Separate indicators shall be provided to show charged/discharged status of the mechanism and open/closed status of the breaker's contacts. The breaker mechanism shall enable to be discharged without closing the main contacts. The manual charging handle shall be interlocked with the manual close button to prevent simultaneous operation.

C. Each main breaker shall be provided with a SEL-751A relay having the following features:

1. Provide the SEL-751A relay with all standard features and the following options:

(a) Undervoltage (27)
(b) Arc-Flash Neutral Overcurrent (50N AF)
(c) Arc-Flash Phase Overcurrent (50P AF)
(d) Time-Overlight

2. The current transformers (CTs) from the Utility Main Breaker connect to the SEL-751A Relay and the relay uses that current along with the light from the optical sensors to declare an arc-flash condition and trip the main breaker.

3. Voltage input to the relay shall be obtained from the source side of the main protective device.

4. Power for the relay shall be derived from the building standby power branch circuit. A 230/120VAC CPT (control power transformer) will be required to power a 120VAC UPS to power the relay.

5. A strobe light shall be provided on the exterior of the electrical room being served by the relay to indicate relay alarms.

6. Fiber optic point sources and fiber optic cable loops shall be provided from the main protective device and all distribution protective devices within the switchboard to the relay per the SEL Application Guide, Volume III AG2011-01. Install 4 cables (bare fiber sensors and/or point sensors) as recommended by the manufacturer throughout the cubicle structure as required to provide protection for all devices in each switchboard and provide high-speed arc-flash detection. The bare-fiber loop sensor cables shall be field cut by the contractor to length and spliced to suit the actual installation. The arc-flash input card and the fast high-current interrupting output option card (4 digital inputs/4 digital outputs) are required. Refer to the SEL Application Guide AG2011-01.

7. The relay will be designed and programmed to trip the main protective device shunt trip mechanism. The Utility Main Circuit Breaker shall trip upon Undervoltage which shall be set up for Phase Loss Protection and shall trip upon arc-flash detection (TOLn) and Overcurrent (50PAF/50NAF).

8. Phase loss protection system shall trip the Utility Main Circuit Breaker under single-phase condition or a voltage imbalance of 12% or more. The system shall not trip on total loss of voltage on all phases and shall have a built-in time delay with a range of 3 - 12 seconds.

9. On the front panel program one switch to manually TRIP the Utility Main Circuit breaker with a programmed 15 second delay. Disable the other three switches.

10. On the front panel the two standard LED indicating lights indicate Enabled and Tripped. Program the following functions to an indicating LED: Undervoltage, Arc-Flash Neutral Overcurrent, Arc-Flash Phase Overcurrent, and Time-Overlight. The remaining 2 LED indicating lights shall not be used.

11. Provide standard features and all options as required to achieve the above functions. Provide power supply, fiber optic cable/sensors and all interconnecting cables as required. Installation shall comply with all manufacturer's requirements and installation instructions.

12. The relay and sensors have factory settings, but field programming will be required to setup the system.

13. Test and commission the arc-flash detection scheme and the Undervoltage component to make sure it operates properly. Refer to the SEL Application Guide AG2011-01.

2.05 DISTRIBUTION PROTECTIVE DEVICES

A. Provide molded case circuit breakers

1. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the Drawings or specified herein.
2. Circuit breakers 600 amps or less shall be of the quick-make, quick-break, trip-free thermal magnetic type.
3. Circuit breakers greater than 600 amps shall be of the quick-make, quick-break, trip-free, solid state type. Solid state breaker trip functions shall include adjustments for continuous amperage, long time pickup and delay, instantaneous, and ground-fault pickup and delay.
4. Circuit breakers shall be bolted to the switchboard bus.
5. Provide shunt trip device to electrically trip circuit breakers where indicated on the Drawings.

2.06 AUXILIARY EQUIPMENT

A. Identification
   1. Refer to Section 26 0000 - Electrical General for nameplate requirements.

B. Metering
   1. Provide a multi-function, high accuracy digital power metering instrumentation module equipped with an LCD display. The module shall provide measurements for current, voltage and power parameters as follows:
      a. Phase currents, phase voltages, average phase current, average phase voltage, amp demand, neutral current, kW, kW demand, kW hours, kVAR, kVAR hours, power factor, and frequency.

C. Infrared (IR) Viewing Windows
   1. Service entrance switchboard shall be manufactured with large format infrared (IR) viewing windows in the front and side of the main incoming section as required for infrared scanning of the main cable terminations within this section (phase and neutral connections). IR viewing windows shall have minimum viewing aperture dimensions of 21-inch x 6-inch and be short wave, mid wave, long wave and ultraviolet capable as well as being capable of visual inspections. Provide IR windows by IRISS or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install switchboard on 3" high concrete pad, the horizontal dimensions of which shall exceed the base dimensions of the switchboard by 3" on all sides.

B. Lace and group conductors installed with nylon tie straps. Only one conductor shall be installed under each terminal. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Un-insulated conductor shall not extend beyond 1/8" from terminal lug.

C. Terminations shall be performed using the manufacturers recommended tools, hardware, and written procedures. Bolted terminations shall be bolted to torque levels in accordance with equipment manufacturers published data utilizing a torque wrench that has been calibrated and is appropriate for the application. In the absence of connector or equipment manufacturer's recommended torque values, use those specified in UL 486A and UL 486B. Compression Tool die sizes and bolt torque data shall be provided on the shop drawings for use during installation.

D. Do not splice conductors in switchboard. Where required, install junction box adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

E. Maintain conductor phase color code requirement described in the conductors and cables section of the Specifications.

F. Switchboard name/designation shall be labeled per the requirements of Section 26 0000 - Electrical General 2.2 A, as well as each individual feeder breaker/fused switch and branch circuit breaker/fused switch.

G. Any circuit breaker provided with arc energy reducing maintenance switch shall be labeled “BREAKER IS PROVIDED WITH ARC ENERGY REDUCING MAINTENANCE SWITCH”. Labeling shall be per the requirements of Section 26 0000 – Electrical General 2.2A.

H. The SEL751A relay shall be commissioned.

3.2 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Circuit breaker settings shall be adjusted as noted in the Protective Device Coordination Study.

C. Circuit breaker adjustments shall be performed as directed by the Engineer at project completion.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

B. Provide the panelboards indicated on the Drawings complete with overcurrent protection devices and spaces.

C. This section includes panelboards and distribution panelboards and associated auxiliary equipment rated 600 V or less as shown on the drawings.

D. Refer to panel schedule and one-line power diagram on drawings for specific requirements of each panel.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install panelboards, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.03 QUALITY ASSURANCE

A. Panels shall be factory assembled.

B. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications and electrical equipment to ensure panel access and so that clearance minimums are provided.

C. Components and installation shall be in accordance with NFPA 70, “National Electrical Code,” NEMA PBI, “Panelboards” and UL67 and UL50.

D. Panelboards shall be listed and identified for use with 75 degrees C rated conductors.

1.04 SUBMITTALS

A. Refer to Section 26 0000 - Electrical General for submittal requirements.

B. Manufacturers Product Data:
   1. Submit material Specifications and installation data for products specified under Part 2 - Products to include:
      a. Overcurrent protection devices
      b. Panelboards

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the Contract Drawings.
   1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
   2. Include bussing diagram indicating each bussing overcurrent protection device position.

3. Provide a schedule indicating overcurrent protection device type, trip and size, poles, frame type, interrupting capacity.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Panelboard manufacturer shall be:
1. Siemens
2. Square D
3. ABB - General Electric
4. Cutler-Hammer

2.02 GENERAL REQUIREMENTS

A. All panels and overcurrent protection devices shall be UL Listed and bear a UL Label. Where panel serves as service entrance equipment, panel shall bear a UL Label indicating suitability as service entrance equipment.

B. Panels shall be of the dead front safety type.

C. Provide panels complete with factory assembled circuit breakers or fuses connected to the bus bars in the positions shown on the panel schedules.

D. Provide all panelboards fully rated to the A.I.C. ratings noted on the schedules, but not less than 10,000 amperes for 120/208 volt panelboards and not less than 14,000 amperes for 277/480 volt panelboards. All devices in a panelboard shall be rated for the A.I.C. ratings shown for the panelboard.

2.03 BUSSING AND INTERIORS

A. All bus bars shall be copper. Main lugs and main overcurrent protection devices shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain a full size grounding bus. All panelboards shall contain a full size insulated neutral bus unless otherwise indicated on the drawings.

B. The neutral and ground bus shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

C. Where designated on panel schedule as “space,” include all necessary bussing, device support and connections. Provide blank cover for each space.

D. Where specified or indicated on the drawings, provide sub-feed lugs adjacent to the mains or feed-through lugs opposite end of mains and increase box heights to provide additional cable bending and termination space. Lugs to be the same size and capacity as mains and rated for aluminum or copper conductor terminations.

2.04 ENCLOSURES

A. Panelboard width shall not be less than twenty inches unless indicated on the drawings (32" minimum for distribution panelboards).

B. Provide concealed captive clamping devices, concealed hinges and chrome lock for all flush mounted panels. Key all panels throughout project alike.

C. Where two section panels are required, both sections shall have fully rated bus, separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims for each section.

D. Panelboard trims for surface mounted panelboards shall be continuously hinged on one side so that when opened, wiring gutters are completely exposed.

E. Provide a label for each branch circuit, feeder, and main circuit breaker in distribution panels, permanently attached per the requirements of Section 26 0000 - Electrical General, 2.02A.

F. Cabinets, flush or surface mounted as indicated. NEMA PB-1, Type 1 enclosure, except where the following enclosure requirements are indicated:
   1. NEMA 250, Type 3R - Raintight.
   2. NEMA 250, Type 3S - Raintight and dust tight.
   3. NEMA 250, Type 4X - Corrosion-resistant stainless steel enclosure, watertight, dust tight, and resistant to oil and coolant seepage. This type shall be used in kitchen areas.
   4. NEMA 250, Type 12 - Dust tight, dripproof, and resistant to oil and coolant seepage.

G. Enclosure shall be fabricated with galvanized steel. Trims shall have electrostatic applied ANSI gray enamel finish and adjustable indicating trim clamps for securing trim to the enclosure. Screwed-on trims shall not be acceptable. Trim shall have an angle support along the bottom serving as a support between trim and enclosure for safe installation and removal of trim.

H. Exterior Panels: Panelboards mounted outside of building shall be in NEMA type 3R enclosures. Panelboards shall have in addition to the standard specified items the following:
   1. Piano hinge
   2. Seams continuously welded
   3. Rolled lip around door and cabinet
   4. No knockouts or holes
   5. Neoprene gaskets on inside of door
   6. Stainless steel hardware
   7. Drip hood at top above door

2.05 CIRCUIT BREAKERS

A. Interrupting rating of all circuit breakers in panelboards shall have UL rating of not less than the RMS symmetrical amps indicated on the Drawings at system voltage. Series rated devices are acceptable with the following exceptions: devices used in distribution serving emergency, standby and multiple elevator loads (selective coordination).

B. Circuit breakers shall be provided with trip rating and poles as indicated on the drawings or specified herein.

C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.

D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panel boards shall be bolted to the bus.

E. Provide the following special devices and accessories when indicated on the drawings or specified herein.
   1. Ground fault interrupting circuit breakers (GFI) where indicated on the drawings.
   2. Provide handle lock-on device (to prevent manually turning off device without removal) for all overcurrent devices where indicated on panelboard schedules, and for those protecting circuits serving fire alarm equipment, and for those dedicated for powering emergency battery-powered unit equipment.
   3. Provide UL Listed “SWD” switching duty circuit breakers on the devices indicated on the drawings.

4. Provide shunt trip device for electrically tripping circuit breakers indicated on the drawings.
5. Overcurrent protective devices for fire alarm circuits shall have handles that are factory-marked in the color red.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide from each flush mounted panelboard four (4) 3/4" empty conduits stubbed out above ceiling line and capped.

B. Install panelboards in accordance with NEMA PB1.1, “General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less” and manufacturer’s written installation instructions.

C. Mount panelboards with top circuit breaker not more than 6'-6" above finished floor.

D. Only one conductor installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Un-insulated conductor shall not extend beyond one-eighth inch from terminal lug.

E. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box.

F. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. Panelboards 600 amp and larger shall be secured by a minimum of eight (8) devices. A 1.5 inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installation on steel structure or sheet rock walls.

G. Maintain conductor phase color code requirements described in the conductors and cables section of the specifications.

H. A typewritten branch circuit directory (based on as-built conditions) shall be provided for each panelboard and load center, permanently mounted on inside of door in a transparent, protective cover. Room number(s) or room name(s) shall be included in the circuit description in coordination with the final naming/numbering scheme for the project (e.g. “Office Receptacles” shall read “Office Receptacles – Rm. 202, 203”).

I. Any circuit breaker provided with arc energy reducing maintenance switch shall be labeled “BREAKER IS PROVIDED WITH ARC ENERGY REDUCING MAINTENANCE SWITCH”. Labeling shall be per the requirements of Section 26 0000 – Electrical General 2.02A.

J. Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, “Application Guide for Ground Fault Circuit Interrupters.”

K. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

L. Mounting of all panelboards and all hardware used for mounting shall be in accordance with the seismic criteria per the applicable building code.

END OF SECTION

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SECTION 26 2726
WIRING DEVICES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install wiring devices, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. The following manufacturers are allowed:

1. Hubbell
2. Pass & Seymour
3. Cooper
4. Leviton
5. Thomas & Betts/Steel City
6. Walker/Wiremold

When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes receptacles, connectors, switches, dimmers, timeclocks and coverplates.

1.03 QUALITY ASSURANCE

A. Wiring devices shall comply with applicable sections of NEMA Standard WD-1, NFPA 70, Article 100.

B. All special purpose receptacles shall be NEMA standard configuration.

C. Comparative devices by acceptable manufacturers are equal.

PART 2 – PRODUCTS

2.01 WIRING DEVICE DESCRIPTION AND MANUFACTURER

A. Single & Duplex Receptacles (20 Amp)

1. Single or duplex type receptacle as indicated. 125V/20/A/2P/3W/G rating - NEMA - 5-20R type.
2. Face color shall be white in all finished spaces (red where on emergency circuit), grey in unfinished spaces and warehouse(red where on emergency circuit).
3. Manufacturer

a. Hubbell 5362

B. GFCI Duplex Receptacles

1. Duplex, feed-thru type ground fault current interrupter receptacle with test/reset buttons. 125V/20A/2P/3W/G rating - NEMA 5-20R type conforming to UL #498, UL #943 Class A and NEMA #WD1-4.02.
2. Manufacturer
   a. Hubbell GF20 Series

C. Isolated Ground Single & Duplex Receptacles

1. Single or duplex type receptacles as indicated. 125V/20A/2P/3W/IG rating - NEMA 5-20R type ground internally isolated from receptacle frame and ground pigtail or terminal screw.
2. Manufacturer
   a. Hubbell IG5352

D. Clock/Flat Screen Receptacles

1. Single type receptacle with a recessed outlet clock hanger type mounting coverplate. 125V/15A/2P/3W/G - NEMA 5-15R type.
2. Manufacturer
   a. Hubbell RR151CH Series

E. Maintained Contact Switches

1. Provide toggle operated switches SPST, DPST, 3-way or 4-way operation as indicated. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, and side wired.
2. Manufacturer
   a. Hubbell 1221 Series (Color to match receptacles).

F. Momentary Contact Switches

1. Provide toggle or key operated switches as indicated with single circuit, 3-position center-off operation. 277V/20A rating, quiet type, momentary contact, spring loaded switch, and green hexagonal ground screw or ground pigtail, back and side wired.
2. Manufacturer
   a. Hubbell HBL 155* (Color to match receptacle).

G. Maintained Contact Slider Type Switch (For Multi-Ganging with Dimmers)

1. Slide-operated switch (to match dimmer), single pole, 3-way or 4-way operation as indicated, 120/277V, 20A rating.
2. Manufacturer
   a. Leviton Monet Series
   b. Lutron Nova T Series

H. Slider Type Incandescent Dimmers

1. Slide operated AC incandescent solid state type dimmer with positive ON/OFF switching, integral surge protection, voltage stabilized output, RFI filtered and maximum lighting level adjustment. 120V/60Hz, unless noted otherwise, with lettering and/or nameplate as indicated. Dimmers shall have lowest profile available (wattage permitting).
2. Manufacturer
   a. Leviton Monet Series

b. Lutron Nova T Series

I. Illuminated Toggle Switches

1. Single pole, 3-way or 4-way, as indicated, conforming to UL #20, NEMA #WDI-3.02 and F.S. #W-S-896E. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, back and side wired. Red colored toggle to glow when switch is on.
2. Manufacturer
   a. Hubbell HBL 1221PL

J. Weather-Resistant Receptacles

1. All 15- and 20-amp receptacles installed in damp or wet locations shall be listed weather-resistant type.

K. Controlled Duplex Receptacles (20 Amp)

1. Duplex type receptacle, 125V/20/A/2P/3W/G controlled by an automatic control device (or by an automatic energy management system) shall be permanently marked with the universal “power” symbol to differentiate them from non-controlled receptacles.
2. Face color shall be white.
3. Manufacturer
   a. Hubbell BR20C1 – Split Wired
   b. Hubbell BR20C2 – Both Outlets Controlled

2.02 COVERPLATE DESCRIPTION AND MANUFACTURER - COVERPLATES

A. Flush Mounted Interior Receptacle/Switch Coverplates

1. Single or multi-gang to match device type. Medium size (4-7/8" min.), standard depth, smooth finish with nylon material.
2. Color to match device color.
3. Coverplates in mechanical/electrical equipment rooms, warehouse and high abuse areas shall be stainless steel, non-magnetic.
4. Manufacturer
   a. Hubbell NPJ Series (nylon)
   b. Hubbell SS Series (stainless steel)

B. Weatherproof Device Coverplates

1. Provide weatherproof “in use” cast aluminum lockable covers.
   a. Hubbell WP Series
   b. Thomas & Betts Russell Stoll Series

2.03 MISCELLANEOUS ITEMS

A. Time Switches

1. Electronic Astronomical Schedule Type
   a. 365 day scheduling, solid state, skip-a-day feature, daylight saving changeover, leap year adjusted with capacitor backup, DPDT-120V/20A rated contacts, light sensor input.
   b. Acceptable Manufacturer
      1) Tork DZS Series (channels as required)

B. Photoelectric Control Switches
   1. Product Description
      a. Raintight photoelectric self-contained control for switching.
      b. Die-cast housing with adjustable sensor.
   2. Manufacturers
      a. AMF/Paragon
      b. Tork 2100 Series

C. Lighting Contactor
   1. Product Description
      a. Multi-pole contactor for switching branch circuit tungsten and ballast lighting and resistant heating loads.
      b. Number of poles as indicated (paralleling multiple contactors is acceptable), poles rated for 20 amperes @ 600V continuous duty.
      c. Mechanically held contactor with coil clearing contacts, operating coil voltage to match circuit characteristics.
      d. Housed in panelboard (if indicated).

D. Poke-thru Floor Devices
   1. Product Description
      a. Refer to drawings for specific features.
      b. Device shall meet UL 514A requirements for scrubwater test standards.
   2. Manufacturer
      a. Hubbell
      b. Walker/Wiremold
      c. Thomas & Betts/Steel City

PART 3 – EXECUTION

3.01 INSTALLATION

A. All dimmer circuits shall have dedicated neutrals.

B. Install decorative plates on switch, receptacle, and blank outlets when indicated.

C. Install devices and wall plates flush and level.

D. Coordinate the exact location of wiring devices with other trades and architectural features. Do not locate devices on two different architectural finishes such as half on wall tile and half on painted surface, unless noted otherwise.

E. Provide plaster rings in areas requiring them due to construction.

F. Where more than one device is indicated, arrange in gangs covered with one coverplate per manufacturer’s instructions.

G. Where dimmer(s) and switch(es) are shown adjacent to one another, switch(es) shall be a maintained contact switch matching dimmer style, so that a common, multi-gang faceplate can be used.

H. Provide 6" long ground wire from grounding lug to all switches and receptacles to a screw type bonding device on the conduit or outlet box.

END OF SECTION

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SECTION 26 2816
DISCONNECT SWITCHES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install disconnect switches, up to 1200 amps, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes fuses.

D. This section includes individually mounted enclosed switches used for the following:
   1. Service disconnecting means.
   2. Feeder and branch-circuit protection.
   3. Motor and equipment disconnecting means.

1.03 SUBMITTALS

A. Product Data: For each type of switch and fuse accessory, and component indicated, include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA AB 1, NEMA KS 1 and UL 98.

C. Comply with NFPA 70.

D. Comply with NEMA FU 1.

E. Source Limitations: Provide fuses from a single manufacturer.

1.05 COORDINATION

A. Coordinate layout and installation of switches and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer of fusible and non-fusible switches shall be Cutler-Hammer, General Electric, Siemens or Square D Company.

B. Manufacturer of fuses shall be Bussman, Gould Shawmutt or Littelfuse.

2.02 ENCLOSED SWITCHES

A. All disconnect switches shall be heavy duty type with lockable handles.

B. Enclosed, non-fusible switch: NEMA KS 1.

C. Enclosed, fusible switch, 800 A and smaller: NEMA KS 1 with clips to accommodate specified fuses and interlocked with cover in closed position.

D. Furnish and install all safety type disconnecting switches indicated on the drawings, specified or required by the National and/or State Electrical Code. Switches shall be externally operable. If the size is not shown on the drawings, the subcontractor shall size the disconnect switch in accordance with name plate data of the equipment they serve.

E. Coordinate with other trades that may provide unit mounted disconnect switches prior to submission of bids.

F. Safety type disconnecting switches shall be heavy duty, 600 volt industrial type with quick-make, quick-break mechanism and interlocking cover which normally cannot be opened when the switch is in the “ON” position. Switches shall be single throw. Fusible switches shall be equipped with fuse clips to receive Bussman fuses. Switches shall have provision for padlocking in the open and closed positions. The operating handle shall be visible in either the on or off position.

G. All fused disconnect switches mounted above 6'-6" shall be hook stick operable.

2.03 INTERIOR

A. Switch blades shall be operated by rotating shaft directly connected to the operating handle mechanism. Switch blades shall be clearly visible in the open position. All switches shall have clear shields over the incoming line lugs. Line shields shall be attached in such a way that switch blade covers or arc shields need not be removed for line installation. Line and load lugs shall be front removable and suitable for copper or aluminum, 60/75 degree wire through 200A sizes, 75 degrees C wire for 400-800A sizes.

B. Current limiting type RK1 dual element time delay fuses shall be furnished and installed as necessary; rating shall be shown on drawing.

2.04 ENCLOSURES

A. All switches shall have NEMA type 1 general purpose enclosures unless indicated otherwise on the drawings. NEMA 3R covers shall be side hinged rather than top hinged. NEMA 1 and 3R switches through 200A sizes shall tangential knockouts for conduit line up against walls. NEMA 12 enclosures through 200A sizes shall be UL Listed for conversion to NEMA 3R usage by opening a factory provided drain hole. All types of enclosures shall have metal nameplates affixed to the cover to show the switch type and rating and clearly indicate “ON” and “OFF” direction of handle movement. Provide hubs on all NEMA 4, 4X, or 3R type disconnects.

B. Provide manufacturer’s standard factory applied finish unless otherwise indicated.

C. Provide phenolic engraved nameplate for disconnect switches.

2.05 CONTROL POLE

A. Where required a direct action interlock or control pole shall be affixed to the switch base in such a manner as to operate positively and only with the opening and closing of the switch power poles.

2.06 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Locate disconnect switches to provide working clearance and full accessibility as required by the National Electrical Code.

B. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5-inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosure shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified. Mount with operating handle at 60" AFF, unless other height is indicated.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device.
      e. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure.

C. Do not splice conductors in enclosure. Where required install junction box or wireway adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

3.03 CONNECTIONS

A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF SECTION

SECTION 26 2818
ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 0000 - Electrical General.

1.02 WORK INCLUDED

A. The work required under this section of the Specifications consists of installation of enclosed circuit breakers up to 800 amps for use on systems 600 volts and below as indicated on the drawings. This Section includes individually mounted enclosed circuit breakers used for the following:
   1. Service disconnecting means.
   2. Feeder and branch-circuit protection.
   3. Motor and equipment disconnecting means.

B. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install enclosed circuit breakers, complete, as indicated on the Drawings and as specified herein.

C. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.03 SUBMITTALS

A. Product Data: For each type of circuit breaker accessory and component indicated, include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA AB 1, NEMA KS 1, UL 98, NEMA Standards Publication AB1-1975 and Federal Specifications W-C-375B classifications.

C. Comply with NFPA 70.

1.05 COORDINATION

A. Coordinate layout and installation of circuit breakers and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer of enclosed circuit breakers shall be Cutler-Hammer, General Electric, Siemens or Square D Company.

2.02 CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.

2.03 ENCLOSURES

A. NEMA 1 enclosures shall be fabricated from sheet steel with ANSI 49 gray baked enamel finish. Knockouts shall be provided in enclosures for circuit breakers through 225A frame sizes. Enclosures shall be provided with a means to padlock the circuit breaker in the OFF position.

B. NEMA 3R enclosures shall be fabricated from galvanically treated steel with ANSI 49 gray baked enamel finish. Enclosures for circuit breaker through 225A frame sizes shall have provisions for interchangeable conduit hubs. Enclosures shall be provided with a means to padlock the plate-type cover closed.

C. Provide manufacturer's factory applied finish unless otherwise indicated.

D. Provide phenolic engraved nameplate for circuit breakers.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Locate enclosed circuit breakers to provide working clearance and full accessibility as required by the National Electrical Code.

B. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified. Mount with operating handle at 60" AFF, unless other height is indicated.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device.

e. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure.

C. Do not splice conductors in enclosure. Where required install junction box or wireway adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

3.03 CONNECTIONS

A. Install equipment grounding connections for circuit breakers with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF SECTION

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SECTION 26 3213
EMERGENCY STANDBY GENERATOR SYSTEM AND SWITCHING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide an emergency standby power system for supply of power in the event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter. System shall comply with NFPA 110 requirements, and the latest requirements of the U.S. Environmental Protection Agency (EPA).

B. Generator shall be rated as follows: 1000 kW, 763 skVA at 30% maximum voltage dip.

C. Provide automatic operation from automatic transfer switch(es) described within this specification so that the system comes on line fully automatically, and after restoration of utility automatically retransfers load to normal power, shuts down the generator and returns to readiness for another operating cycle.

1.02 CODES AND STANDARDS

A. The emergency generator system shall conform to the requirements of the following:
1. NFPA 110 – Emergency and Standby Power Systems
2. NFPA 30 – Flammable and Combustible Liquids Code
3. NFPA 37 – Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines

1.03 MANUFACTURER QUALIFICATIONS

A. This system is designed based upon products of Generac. Caterpillar/Olympian, Cummins/
Onan, MTU/Detroit Diesel, and Kohler are considered to be approved equals provided they meet every portion of this written specification. The manufacturer must be regularly engaged in the production of engine-alternator sets and associated controls for a minimum of ten years, so there is one source of supply and responsibility. The complete engine generator set system shall be supplied by the manufacturer's authorized distributor only.

B. When other than the basis of design equipment is proposed, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

PART 2 – PRODUCTS

2.01 ENGINE

A. The prime mover shall be a liquid cooled, **gaseous fueled** turbo-charged/after cooled engine of 4-cycle design. The engine shall be a single piece, cast block. Multiple blocks combined are not acceptable. The engine will utilize in-cylinder combustion technology, as required, to meet the applicable EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178-D2

Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder.

B. The engine is to be cooled with a unit-mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in **104 degrees Fahrenheit** (40 degrees Celsius) ambient temperature.

C. The intake air filter with replaceable element must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass and replaceable elements. Engine coolant and oil drain extension must be provided to outside the mounting base for cleaner and more convenient engine servicing. A fan guard must be installed for personnel safety.

D. The engine shall have a battery charging DC alternator with a transistorized voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.

E. Engine speed shall be governed by an **electronic** governor to maintain alternator frequency within **0.5%** from no load to full load alternator output. Steady state regulation is to be + **or - 0.25%**.

F. The engine fuel system shall be designed for operation on natural gas having a BTU content of 1000 BTU per cubic foot. A carburetor, secondary regulator, fuel lock-off solenoid and all piping must be installed at the point of manufacturing, terminating at a single pipe opening external to the mounting base. Pressure required is 7 - 16 inches water column, or .35-.50 psi when generator is operating at 100% load. For gensets above 150 kW, pressure required is 1.5 psi minimum, 5 psi maximum.

G. Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature (low coolant level shutdown), overspeed shutdown, overcrank shutdown. These sensors are to be connected to the control panel using a wiring harness with the following features: wire number labeling on each end of the wire run for easy identification, a molded rubber boot to cover the electrical connection on each sensor to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and any moving objects.

H. The engine shall have an engine-mounted, thermostatically-controlled jacket water heater to aid in quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The Contractor shall provide proper branch circuit from normal utility power source.

2.02 ALTERNATOR

A. The alternator shall be a 4-pole revolving field type, for 3-phase, 60 Hz (voltage indicated on Drawings) with a brushless exciter. The stator shall be directly connected to the engine flywheel to ensure permanent alignment. The generator shall meet temperature rise standards for UL 1446 Class H or better varnish. All leads must be extended into the AC connection panel. The alternator shall be protected by an automatic reset field circuit breaker, or over excitation sensing voltage regulator.

B. Load acceptance shall be 100% of nameplate kW rating and meet the requirements of NFPA 110. The engine-generator set shall be so designed that instantaneous voltage dip upon application of nameplate kW/kVA shall not exceed 30% with recovery to stable operation within 10 seconds. Sustained voltage dip data is not acceptable.

C. A solid state voltage regulator designed and built by the engine-generator set manufacturer must be used to control output voltage by varying the exciter magnetic field

to provide + **or - 1%** regulation during stable load conditions. Should an extremely heavy load drop the output frequency, the regulator shall have a voltage drop of 4 volts/hertz to maximize motor starting capability. The frequency at which this drop operation begins must be adjustable, allowing the generator set to be properly matched to the load characteristics ensuring optimum system performance.

D. The voltage regulator must contain a limiting circuit to prevent output voltage surges in excess of 110% of rated voltage during generator set operation. On a loss of the sensing signal, the voltage regulator must shutdown to prevent an overvoltage condition from occurring. A voltage regulator that can go into a full field condition is unacceptable. A rheostat shall provide a minimum of + or - 10% voltage adjustment from the rated value.

E. A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. An isolated neutral lug must be included by the generator set manufacturer to ensure proper sizing.

F. The electric plant shall be mounted with vibration isolators on a welded steel base which shall permit suitable mounting to any level surface.

G. Terminal lugs shall be factory-installed for load-side feeder connections.

2.03 CONTROLS

A. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 1 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting and a fused DC circuit to protect the controls. It shall provide true RMS sensing to ensure AC metering accuracy to within +/- 1% of rated AC voltage (L-L and L-N) and current.

B. The engine-generator set shall contain a complete engine start-stop control which starts the engine on closing contacts and stops the engine on opening contacts. A cyclic cranking limiter shall be provided to open the starting circuit after five attempts if the engine has not started within that time. Engine control modules must be solid state plug-in type for high reliability and easy service. The engine controls shall also include a 3-position selector switch with the following positions: RUN/AUTO/STOP. A red annunciator lamp shall be energized when the switch is not in auto.

C. Safety shutdown monitoring system shall include solid state engine monitor with individual lights and one common external alarm contact indicating the following conditions: Overcrank shutdown, Overspeed shutdown, High Coolant Temperature (Low Coolant Level shutdown), Low Oil Pressure shutdown. Monitoring system shall include lamp test switch or engine control switch for manual reset of tripped conditions. Engine RPM is to be monitored by an independent permanent magnet sensor. If there is a failure in this circuit, the engine must shut down immediately and illuminate an overspeed condition.

D. Engine control panel instrumentation shall consist of an oil pressure gauge, coolant temperature gauge, DC ammeter and an engine run hour meter located on the unit control panel. Alternator instrumentation must include analog or digital meters to indicate output voltage, amperage, kW, kVA, PF and frequency.

E. Provide the following items installed at the factory:
   1. Pre-alarms for low coolant temperature, high water temperature and low oil pressure must be provided to anticipate possible problems before the system becomes inoperative. Yellow lights labeled on the control panel will illuminate should the associated parameter be exceeded.
   2. Engine battery voltage is to be monitored to detect abnormal voltage levels. A light labeled on the control panel will illuminate should a low voltage condition be experienced.
   3. One alarm horn to actuate upon engine fault shutdown.

4. Emergency stop button to immediately shut down the engine upon actuation.

2.04 MISCELLANEOUS EQUIPMENT

A. The following equipment is to be installed at the engine- generator set manufacturer's facility:

1. Exhaust silencer(s) shall be provided of the size as recommended by the manufacturer and shall be critical grade. The silencer(s) shall have a flexible, seamless, stainless steel exhaust connection and rain cap. All components must be properly sized to assure operation without excessive back pressure when installed.
2. Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The automatic battery charger shall be rated no less than 10 amps. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.
3. A heavy duty, lead acid battery set shall be provided by the generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine. Provide all intercell and connecting battery cables as required.
4. Weather Protective Enclosure: The engine-generator set shall be factory enclosed in a heavy gauge steel enclosure constructed with corner posts and powder coated baked finish. The enclosure's finish shall be selected by Architect. The enclosure is to have large, easily opened doors to allow access to the engine, alternator and control panel. Each door is to be fitted with stainless steel, lockable hardware with identical keys. Padlocks do not meet this specification.
5. **Provide Modbus TCP communication interface to communicate with Division 23 Building Automation System.**

The following points shall be monitored.

a. Control Switch Not in Auto
b. Emergency Stop
c. Generator running
d. Overcrank
e. Engine RPM
f. Battery Voltage
g. Low Coolant/Water Temperature
h. High Coolant/Water Temperature Pre-Alarm
i. High Coolant/Water Temperature Shutdown
j. Low Oil Pressure Pre-Alarm
k. Low Oil Pressure Shutdown
l. Overspeed
m. Low Fuel Alarm (Diesel only)
n. Current, per phase RMS and neutral (if applicable)
o. Current Unbalance %
p. Voltage, phase-to-phase and phase-to-neutral
q. Voltage Unbalance %
r. Real power, per phase and 3-phase total
s. Apparent power, per phase and 3-phase total
t. Reactive power, per phase and 3-phase total
u. Power factor, 3-phase total and per phase
v. Frequency
w. Accumulated Energy (MWH, MVAH, and MVARH)
x. Need service

B. The following equipment is to be provided by the engine- generator set manufacturer and shipped loose with the unit with required control wiring furnished and installed by

Contractor:

1. Provide (2) remote annunciator panels for wall mounting. The panel shall have an ALARM switch that when activated silences the audible alarm. A TEST switch must be included to verify the lights are functional. The following alarms shall be included for the remote annunciator:
   a. Overcrank
   b. Low Coolant/Water Temperature
   c. High Coolant/Water Temperature Pre-Alarm
   d. High Coolant/Water Temperature Shutdown
   e. Low Oil Pressure Pre-Alarm
   f. Low Oil Pressure Shutdown
   g. Overspeed
   h. Low Fuel Alarm
   i. Control Switch Not In Auto
   j. Provide a minimum of four (4) spare lights for other potential alarms.
   k. Manual Start Switch and ATS toggle switch(es).

2. Provide a manual breakglass station located on the weatherproof enclosure for shutdown of the generator. Station shall be appropriately labeled.

C. Provide Portable Generator Connection Cabinet for compliance with NEC 700.3(F) & 700.12. Permanent switching provisions shall be made such that a portable or temporary alternate source of power can be connected to the emergency system while the permanent emergency source is disabled for maintenance or repair. Generator connection Cabinet shall include the following capabilities:
   1. Permanent system wiring must not require any modification to accept a connection from a portable or temporary alternate source of power.
   2. Manual Transfer Switch shall be built into the permanent switching provisions such that either the permanent emergency power source or the portable/temporary power source is connected to the emergency power system. Switch shall prevent inadvertent interconnection of power sources.
   3. Auto start signal shall be provided to the portable or temporary alternate source of power in accordance with NEC 700.12
   4. Phase rotation and system bonding shall be marked at the permanent connection point for a portable or temporary alternate source of power.
   5. A location remote to the generator or at another facility monitoring system shall be able to receive a signal from the permanent switching provisions to indicate that the permanent emergency standby power source is disconnected from the emergency system.

PART 3 - AUTOMATIC TRANSFER SWITCH

3.01 SCOPE

A. Furnish and install the 4-pole automatic transfer switch(es) with amperage, voltage, and withstand rating as shown on the plans. Each automatic transfer shall consist of a double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. Automatic transfer switch serving tenant's standby MDF room loads shall include Bypass Isolation. Automatic transfer switches serving building life safety loads do not require Bypass Isolation. All transfer switches and controllers shall be the products of the same manufacturer.

3.02 CODES AND STANDARDS

A. The automatic transfer switch(es) and controls shall conform to the requirements of:

1. UL 1008 – Standard for Transfer Switch Equipment
2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
3. NFPA 70 – National Electrical Code
4. NFPA 110 – Emergency and Standby Power Systems
5. IEEE Standard 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
6. NEMA Standard ICS10-1993 (formerly ICS2-447) – AC Automatic Transfer Switches
7. UL 508 Industrial Control Equipment

3.03 ACCEPTABLE MANUFACTURERS

A. Automatic transfer switch(es) shall be based on ASCO 7000 Series. Other acceptable manufacturers shall be Russell.

3.04 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

C. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

D. The ATS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.

3.05 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

C. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
1. IEEE472 (ANSI C37.90A) Ring Wave Test
2. ENC55011 1991 Class A Conducted and Radiated Emission
3. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact & Air Discharge
4. EN61000-4-3 Radiated Electromagnetic Field Immunity
5. EN61000-4-4 Electrical Fast Transient Immunity
6. EN61000-4-5 Surge Immunity
7. ENV50141 HF Conducted Disturbances Immunity

3.06 ENCLOSURE

A. The ATS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.

3.07 STANDARD FEATURES

A. A three position momentary-type test switch shall be provided for the test/automatic/reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

F. An inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

G. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1. Enable or disable the routine.
2. Enable or disable transfer of the load during routine.
3. Set the start time,

- time of day
- day of week
- week of month (1st, 2nd, 3rd, 4th, alternate or every).

4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

H. System Status: The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two (2) times. This screen shall display a clear description of the active operating sequence and switch position. For example,

Normal Failed
Load on Normal
TD Normal to Emerg
2min15s

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

I. Data Logging: The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
   1. Event Logging
      a. Data and time and reason for transfer normal to emergency
      b. Data and time and reason for transfer emergency to normal
      c. Data and time and reason for engine start
      d. Data and time engine stopped
      e. Data and time emergency source available
      f. Data and time emergency source not available
   2. Statistical Data
      a. Total number of transfers
      b. Total number of transfers due to source failure
      c. Total number of days controller is energized
      d. Total number of hours both normal and emergency sources are available

3.08 TRANSITION FEATURES

A. Each transfer switch shall be open-transition type.

3.09 BYPASS ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

3.10 ACCESSORIES

A. Provide two double throw contacts that operate when emergency source voltage is present at the switch terminals, ASCO accessory 18B.

B. Provide two double throw contacts that operate when normal source voltage is present at the switch terminals, ASCO accessory 18G.

C. Provide a selective load disconnect circuit (Elevator Contacts) that operates with an adjustable time delay from 1 second to 5 minutes before transfer of the ATS to emergency and resets 1 second to 5 minutes after the retransfer to normal, ASCO accessory 31Z.

3.11 CONTROLLER DISPLAY AND KEYPAD

A. A 4-line, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration

(Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.12 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout/Trip	Pickup/Reset
Undervoltage	N&E,3Ø	70 to 98%	85 to 100%
Overvoltage	N&E,3Ø	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below drop-out

B. Repetitive accuracy of all settings shall be within 0.5% over an operating temperature range of -20 degrees C to 60 degrees C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

3.13 TIME DELAYS

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on retransfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control.

The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only
2. Prior to and after transfer
3. Normal to emergency only
4. Emergency to normal only
5. Normal to emergency and emergency to normal
6. All transfer conditions or only when both sources are available

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:

1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.14 WITHSTAND AND CLOSING RATINGS

A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The ATS shall be UL Listed in accordance with UL 1008 and be labeled in accordance with that standard's 1.5 and 3-cycle long-time ratings. ATSs which are not tested and labeled with 1.5 and 3-cycle (any breaker) ratings and have series or specific breaker ratings only are not acceptable.

3.15 SERVICE REPRESENTATION

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

C. The automatic transfer switch(es) shall be supplied by the generator set distributor in order to establish and maintain a single source of system responsibility and coordination.

PART 4 – MISCELLANEOUS

4.01 CONCRETE PAD

A. Generators located outdoors shall be mounted on a steel reinforced concrete pad, raised 6" above grade, a minimum of 12" thick, or as recommended by the generator manufacturer. Pad shall extend a minimum of 12" beyond the extents of the generator on all four sides. Concrete pad shall be chamfered on all four edges. Pad shall be sloped to prevent the collection of water.

4.02 SERVICE PLATFORM

A. For installations where the service door opening is greater than 30" above grade, provide aluminum stairs and work platform with handrails for accessing generator enclosure doors. Platform shall be a minimum of 42" wide. Decking shall be slip resistant perforated extruded aluminum self-mating deck. The legs shall be designed to support the stair and landing sections.

4.03 FACTORY TESTING

A. Before shipment of the equipment, the engine-generator set shall be tested under rated 0.8 PF load for performance and proper functioning of control and interfacing circuits. A factory test report shall be made available upon request. Tests shall include:
   1. Verifying all safety shutdowns are functioning properly.
   2. Both no-load and full-load steady state voltage checks shall be tested and measured line to line and speed (frequency) checks. Line-to-line current at rated voltage shall also be tested and measured.

4.04 OWNER'S MANUALS

A. **Three (3) sets** of Owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

4.05 INSTALLATION

A. The Contractor shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the Engineer.

B. The Contractor shall furnish to the Owner a manufacturer tank chart with inches-to-gallon conversions. The Contractor shall mount a laminated copy of the chart inside the generator module for use by the delivery operator.

4.06 SERVICE

A. Supplier of the electric plant and associated items shall have permanent service and parts facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24-hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the Owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

4.07 WARRANTY

A. The standby electric generating system components, complete engine-generator set and automatic transfer switch shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five years. Such defective parts shall be repaired or replaced at the manufacturer's option. In addition, all labor for the replacement of these parts for the engine-generator set and transfer switch will be covered for the first two years. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable and must be covered by the engine manufacturer. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate parts, service and warranty support.

4.08 CHECKOUT & STARTUP

A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to check out the completed installation and to perform an initial startup inspection to include:
   1. Ensuring the engine starts (both hot and cold) within the specified time.
   2. Verification of engine parameters within specification.
   3. Set no load frequency and voltage.
   4. Test all automatic shutdowns of the engine-generator.
   5. Perform a full load test of the electric plant, ensuring full load frequency and voltage are within specification by using building load supplemented with load banks. Test shall be per NFPA 110-2013 Section 7.13.

4.09 SUBMITTALS

A. Provide complete sets of Engineering Submittals for approval prior to production release, showing all components, in addition to the engine, generator and automatic transfer switch. Submittals shall include complete system interconnection wiring diagrams and manufacturer's warranty form indicating compliance with these specifications.

4.10 SUBSTITUTIONS

A. The emergency power system has been designed to the specified manufacturer's electrical and physical characteristics, including the equipment sizing, spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components. Should any substitutions be made, the Contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs which may result from such substitutions. Alternate equipment suppliers shall furnish equipment submittals 14 days prior to bid date for approval to bid. As part of the submittals, the substitute manufacturer shall supply as a minimum engine, alternator, control panel and automatic transfer switch wiring diagrams and schematics. A separate list of all printed circuit boards with part numbers and current pricing must also be included.

4.11 TRAINING

A. Provide training and video as required by Specification 017900 and 019113.

END OF SECTION

SECTION 26 4113
LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. The work covered by this section of the specifications consists of the design, labor, materials and items of service required for the completion of a functional and unobtrusive lightning protection system as approved by the Engineer, and in strict accordance with this section of the specifications and any applicable Contract Drawings.

B. If any departure from the Contract Drawings or Submittal Drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the Engineer for approval. No such departures shall be made without the prior written approval of the Engineer.

C. The following specifications and standards of the latest issue form a part of this specification: 1) Lightning Protection Institute Installation Code LPI 175; 2) UL Standard 96A; 3) ANSI C2-81.

1.02 QUALITY ASSURANCE

A. The lightning protection system shall conform to the requirements of the Lightning Protection Institute and NFPA Standards for Lightning Protection Systems. The LPI System Certification shall be furnished and submitted.

B. The system to be furnished under this specification shall be UL Listed by an approved and fully certified manufacturer in good standing of the Lightning Protection Institute. All material specified for this work is manufactured by Thompson Lightning Protection, Inc., East Coast Lightning, Erico or equal.

1.03 SHOP DRAWINGS

A. Complete shop drawings shall include details and drawings showing the type, size and locations of all air terminals, bonding plates, down conductors, conductor fasteners, masonry anchors and ground rods shall be submitted to the Engineer for approval prior to start of work.

B. Samples and pertinent catalog data shall be submitted to the Engineer for approval upon request.

C. Drawings must bear the stamp of the certified master installer designer.

D. Copy of certifications of designer must be submitted.

PART 2 - PRODUCTS

2.01 STANDARD

A. All equipment used in this installation shall be UL inspected, approved and properly labeled.

B. All equipment shall be new, the product of a single manufacturer as outlined above, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and Code requirements.

C. All materials shall conform to UL-96A Class I requirements.

2.02 EQUIPMENT

A. All materials shall be the minimum size and weight in accordance with LPI and NFPA requirements.

B. All vertical conductors shall be copper, and roof-mounted horizontal conductors shall be copper or aluminum (conductors must be galvanically compatible with adjoining surfaces).

C. Air terminals shall be copper or aluminum (selection to be galvanically compatible with adjoining surfaces), and shall project 10" minimum above the object to be protected. Locate and space according to LPI and NFPA requirements. Length and diameter of terminals shall be dependent upon material used and installation class.

D. Air terminal bases shall have bolt pressure cable connections and shall be securely mounted with stainless steel screws or bolts. Bases on built-up tar and gravel roofs shall be secured properly and shall have a minimum surface contact area of 18.5 sq. inches. Crimp type connectors at bases are not acceptable.

E. Ground rods shall be a minimum of 3/4" in diameter and 10'-0" long. Exothermic connections shall be used for below grade installations of rods and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The installation shall be accomplished by an experienced installer who is a Certified Master Installer of the LPI manufacturer as listed above or his authorized LPI Certified Master Installer representative.

B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible.

C. Ground rods shall be installed 3'-0" from building foundation. Resistance to ground at each ground rod shall not exceed 5 ohms.

D. The number of down conductors, size, type and location of grounds and building connections shall be as required by the standards of this specification. A complete cable system with related air terminals, splices, and bonds, etc., shall be used on the roof. Down conductors shall be installed in 1-1/4" PVC conduit concealed in or behind building walls or columns. Down conductors shall be connected to ground rods not less than 18" below the bottom of the floor slab.

E. Copper equipment shall not be connected to aluminum surfaces except by means of an LPI approved bimetal transition fitting. Lead coating is not to be accepted as a bimetal transition.
   1. Metals acceptable for use with copper:
      a. Nickel, brass, tin, lead, stainless steel, and monel.
   2. Metals acceptable for use with aluminum:
      a. Magnesium, zinc, galvanized steel, stainless steel, lead, and wrought iron.

F. Bending radius of lightning protection conductors shall not be less than 8", nor shall any bend form an angle less than 90 degrees.

G. Metal equipment, piping or other objects within 6' of a lightning conductor shall be connected to the lightning protection system.

3.02 COORDINATION

A. All roof mounted mechanical equipment shall be bonded to lightning protection grid.

B. It shall be the responsibility of the lightning protection installer to interconnect with other building ground systems, including electrical, water and telephone systems and also to ensure that proper arresters have been installed on the power service.

C. Lightning protection installer shall obtain approval from the Architect and the roofing contractor regarding method of fastening conductors and air terminals to the roof, parapet and appurtenances prior to installation.

3.03 COMPLETION

A. The lightning protection installer shall secure and deliver the LPI System Certification to the project manager for delivery to the Owner upon completion of the installation, in addition to the UL master label certification.

B. The Contractor shall also submit copies of as-built shop drawings along with the completed LPI Certified System Application.

END OF SECTION

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SECTION 26 4313
SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

1.01 DESCRIPTION

A. These specifications describe the electrical and mechanical requirements for a hybrid high-energy power conditioning filter incorporating surge protective devices and high-frequency electrical line noise filtering. The specified unit shall provide effective high-energy surge protection, surge current diversion, high-frequency attenuation, and line control in ANSI/IEEE C62.41.1-2002 environments connected on the load side of the facility's meter or main overcurrent device. The unit shall be connected in parallel with the facility's wiring system.

1.02 QUALITY ASSURANCE

A. The requirements of the following standards shall become a part of this Specification by reference:
   1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41.1-2002, C62.41.2-2002, and C62.45-2002)
   2. Canadian Standards Association (CSA)
   3. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
   4. National Electrical Manufacturers Association (NEMA)
   5. National Fire Protection Association (NFPA 70 (NEC), 75 and 78)
   6. Underwriters Laboratories Inc. (UL 1449 3rd Edition and 1283)

   The unit shall be UL and cUL 1449 3rd Edition Listed as a Surge Protective Device.

B. Acceptable Manufacturers
   1. Current Technology
   2. Thor Systems
   3. Emerson/ASCO

C. Testing: The unit shall be thoroughly factory-tested before shipment. Testing of each unit shall include but shall not be limited to quality assurance checks, MCOV and clamping voltage verification tests.

D. Warranty: The manufacturer shall provide a minimum 5-year warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

E. Submittal Documentation: Documentation of unit's UL 1449 3rd Edition Voltage Protective Rating (VPR) shall be included as required product data submittal information. Manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41.1-2002, C62.41.2-2002, and C62.45-2002 Guidelines. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the specified unit. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENT

A. The unit shall provide all modes of protection: line to neutral, line to ground, and neutral to ground.

B. High Frequency Tracking Filter: The unit shall include a UL1283 high-frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error producing transients and electrical line noise to harmless levels, thus eliminating disturbances which may lead to system upset.

C. Unit Status Indicators: The unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the status of MOV fusing.

D. Transient Counter: Front cover mounted transient counter (LCD or LED) shall totalize surges for all modes.

E. Nominal discharge current rating shall be I_n 20 kA.

F. Minimum SPD fault current ratings shall be 100Kaic.

PART 3 - APPLICATIONS

3.01 SERVICE ENTRANCE/MAIN DISTRIBUTION APPLICATIONS

A. The following table will indicate appropriate model numbers based on the electrical system ampacity. Surge current ratings are based on the Site Shield Risk Assessment Spreadsheet (TSI 067 3gSSH/r3).

B. SPDs connected to service equipment shall be listed as a type 1 SPD per UL1449 3rd Edition and shall have integral disconnect switch, and shall be connected to bus on the load side of the main switch.

SERVICE ENTRANCE/MAIN DISTRIBUTION APPLICATIONS					
Manufacturers' Models			Electrical System Ampacity @ SPD Install Point	Surge Protection (kA)	
Current Tech	Thor Systems	ASCO		Per Mode	Per Phase
TG 300	TSrc 300	560 75	4000 – 6000A	300	600
TG 250	TSrc 250	560 50	2000 – 3000A	250	500
TG 200	TSrc 200	560 40	1200 – 1600A	200	400
TG 150	TSrc 150	560 32	600 – 1000A	150	300
TG 100	TSrc 100	560 25	125 – 400A	100	200

3.02 PANELBOARDS AND BRANCH PANEL APPLICATIONS

A. As indicated on the Drawings, provide a panelboard with externally mounted SPD with high-frequency filtering per requirements listed in this specification. Provide number of breakers, voltage/phases as indicated on the Drawings. SPD shall physically connect to the top or bottom of panelboard allowing for SPD to be repaired or replaced without opening the dead front of the panelboard.

B. SPDs connected to Panelboards or Branch Panels shall be listed as a type 1 or type 2 SPD per UL1449 3rd Edition and shall be circuit breaker connected.

C. The following table indicates appropriate model numbers based on the electrical system ampacity. Surge current ratings are based on Site Shield Risk Assessment Spreadsheet (attached #TSI 067 3gSSH/r3). SPDs connected to Panelboards and Branch Panels shall be listed as a type 1 or type 2 SPD per UL 1449 3rd Edition and shall be 30 Amp circuit breaker connected.

PANELBOARDS AND BRANCH PANEL APPLICATIONS					
Manufacturer/Model Nos.			Electrical System Ampacity @ SPD Install Point	Surge Protection (kA)	
Current Tech	Thor Systems	ASCO		Per Mode	Per Phase
EGPE2 150	TSnc 150	440 P30	600A	150	300
EGPE2 100	TSnc 100	440 P20	125 – 400A	100	200
EGPE2 60	TSnc 050	440 P10	Up to 100A	50	100

PART 4 - EXECUTION

4.01 INSTALLATION

A. Install wiring connection to distribution system as indicated on the Drawings. Wiring length should be kept to an absolute minimum (3' or less) and be as straight as possible.

B. Wire sizes to Service Entrance/Main Distribution SPD should be 4#6, 1#6 G - 1" conduit.

C. Wire sizes to Panelboard and Branch Panel SPD should be as indicated 4#10, 1#10G – ¾" conduit.

END OF SECTION

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SECTION 26 5100
LIGHTING

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section specifies the lighting system requirements.

B. All fixtures shall be current source, provided with lamps ready to use.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Refer to another division for the ceiling systems.

B. Lighting system shall be coordinated with the ceilings.

1.03 SUBSTITUTIONS/VALUE ENGINEERING/PRICING

A. Substitution/value engineering requests shall be accompanied by complete manufacturers data with model numbers, cut sheets with options indicated, and a full photometric report, a computer generated point by point calculation shall be provided.

B. All substitution requests shall be submitted in completion to Engineer at least 10 days prior to bid date.

C. Pricing for lighting fixtures shall be separate from pricing for lighting controls (occupancy sensors, relay controls, dimming).

PART 2 – PRODUCTS

2.01 BALLASTS/DRIVERS

A. All LED drivers shall be constant current type with 0-10V dimming capability and proper heat dissipation.

B. Voltage shall be as defined on the drawings. Universal voltage shall be provided when available.

C. LED drivers shall have a 10-year minimum factory warranty.

D. LED drivers in unconditioned warehouses shall be suitable for ambient temperatures from -40°F(-40°C) to 131°F(55°C).

E. Electronic driver for LED fixtures shall include the following:

1. Rated for a minimum 100,000 hours of life
2. Class A sound rating
3. Total Harmonic Distortion: 15% or less
4. Power Factor: 0.9

2.02 LAMPS

A. LED lamps shall be long-life LEDs rated at 100,000 hours minimum, L70. Color shall be 5000K or 6000K with a maximum 2.5 step MacAdam (2.5 SDCM) color variation.

B. Minimum 80CRI.

C. Tested to LM-79, LM-80 and TM-21

D. LED lamps shall have a 10-year minimum factory warranty.

2.03 LIGHTING FIXTURES

A. Letter designations beside outlet symbols on Drawings correspond to letter designations in Lighting Fixture Schedule.

B. Recessed fixtures, where used in an insulated ceiling, shall be equipped with thermal protection and shall bear the UL label indicating the suitability for such use.

C. Lens material for recessed fixtures shall be 100% virgin acrylic, 0.125" thick in a square prism pattern similar to KSH-K-12 or as scheduled in Lighting Fixture Schedule.

D. Refer to lighting fixture schedule for other requirements, accessories and for additional fixture description.

E. Site lighting poles shall meet or exceed the local wind loading requirements of authority having jurisdiction.

F. Concrete pole bases shall be required for site lighting poles.

PART 3 – EXECUTION

3.01 LIGHTING FIXTURES

A. Provide lighting fixtures at all locations indicated by distinctive symbols or notes on the Drawings.

B. Lighting fixtures shall be secured to ceiling grid with clips or screws and two #12 steel wires mounted to opposite corners of light fixture secured to structure.

C. Locations of lighting fixtures on the electrical drawings are approximate. Refer to Architectural reflected ceiling plan for actual locations of fixtures and mounting heights.

D. Lighting fixtures installed in plaster and stucco ceiling shall have plaster frame and shall be of the flanged type.

E. Fixtures recessed in concealed-spline tile and in gypsum board ceilings shall be flanged.

F. Surface or recessed fixtures in or on plastered ceilings shall be supported from pieces of support channel spanning across the main supporting channels and shall not depend on the metal lath for support.

G. Each recessed lighting fixture shall have a trim to match the type of ceiling (exposed grid, metal panel, etc.) in which it is being installed, except where noted otherwise on the plans.

H. Each lighting fixture recessed in a concrete wall shall have a junction box or wiring compartment provided inside the fixture housing. Provide conduit access into the fixture concealed.

END OF SECTION

SECTION 28 3000
TWO-WAY EMERGENCY COMMUNICATION SYSTEM

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Section 26 0000 - Electrical General shall be considered a part of this section and shall have the same force as if printed herein full.

B. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and/or on the Drawings.

1.02 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install communication base system, call boxes, graphics, labeling and all associated wiring.

1.03 QUALITY ASSURANCE

A. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications.

B. Components and installation shall be in accordance with the requirements of the International Building Code, NFPA, and ADAAG.

1.04 SHOP DRAWINGS

A. Shop drawings shall be submitted and shall contain the following:

1. Specification sheet/sheets of technical data on each hardware component
2. Specification sheet(s) on wiring to be utilized
3. One-line schematic riser diagram made specifically for this job
4. Calculation for sizing batteries and power supplies
5. Sequence of operation for the entire system
6. Verification of central supervising station (UL Certified)
7. Equipment and service warranty
8. Scaled floor plans showing device locations and wire routing

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Two-Way Communication System Manufacturer

1. Rath Area of Refuge
2. Approved Equal

2.02 SYSTEM COMPONENTS

A. The Base Station shall be installed in location(s) shown on the drawings, and shall have the following components:

1. Stainless steel or powder-coated steel housing, red coil cord emergency Handset, 120vac powered, with battery back-up power for 4 hours operation of any call box and base station.
2. Audible and visual indicator that a call box has been activated.
3. Capable of handling up a minimum of twelve (12) call boxes.
4. 24vac power supply model capable of supplying power to a minimum of 40 call boxes.
5. Must allow rescue personnel to communicate with all call boxes or individual call boxes.
6. The ability to be programmed with up to five (5) emergency phone numbers.

B. Each Call Box shall be installed in location shown on the drawings, and shall have the following features:

1. Must comply with Americans with Disabilities Act (ADA)
2. Hands-free speakerphone with an LED to indicate status of call
3. Programmable for specific location message of the Call Box. This allows rescue personnel to know the location of the activated Call Box.
4. Built-in battery back-up power for a minimum of four (4) hours of talk time.
5. Braille faceplate located no higher than 48" for front reach and 54" for side reach above ground level to ensure conformance with the ADA requirements.

2.03 SYSTEM FEATURES

A. Operational Communication Features

1. Call Box shall be hands-free operable and be a push-button-once to talk system. Once the button has been pushed, the Call Box will call the Base Station. If no answer at the Base Station, it will automatically call preprogrammed emergency numbers. The Call Box must be capable of being programmed with up to 5 emergency numbers to activate two-way off-site person to person voice communications.
2. Call Box shall have Location Message capability. Call Box must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center.
3. Call Box shall be capable of allowing the called party to replay the Location Message if necessary to ensure an understanding of the caller location.
4. Once call has been made (button pushed), the call can be terminated only by the called party.
5. Call Box must have a red LED that will light up upon push of the button. The light shall be a solid color when the Call Box is activated, and will flash when call has been answered.
6. Call Box must be capable of being programmed and reprogrammed on-site and remotely.
7. Operating temperature of call box shall be between -40 deg. F to 150 deg. F.
8. Call Box shall have EEPROM memory to protect programming.

B. Graphics and Labeling

1. Base Station shall have appropriate wording to indicate the location of each call box, located adjacent to the LED associated with each call box.
2. Call Box graphics must include “Help Phone,” international phone symbol and raised Braille lettering.
3. System shall consist of a minimum of one (1) 120/277VAC edge lit sign, and a “location” and “instruction” sign to clearly indicate location of designated area. A tactile sign with raised letter and Braille shall be located at entrance to area.

C. Cabling
1. Cabling shall meet the applicable requirements for pathway survivability. Cabling shall consist of one or more of the following:
   a. 2-hour fire-rated circuit integrity (CI) cable
   b. 2-hour fire rated cable system
   c. 2-hour fire-rated enclosure or protected area.

PART 3 - EXECUTION

3.01 MONITORING

A. Contractor shall coordinate with the owner to arrange for an off-site monitoring agency associated with this communication system.

3.02 TESTING

A. Prior to completion, contractor shall test the functionality of all call boxes, both for connection to the base station, as well as for successful communication with off-site monitoring agency.

3.03 WARRANTY

A. System shall be warranted for a period of three years.

END OF SECTION

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SECTION 26 8115

EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Furnish, install, and test a complete and operating Emergency Responder Radio Coverage System. The system shall support Fire Department and Emergency Medical Services ("Emergency Responders") radio system(s) as well as other responders in accordance with the Authorities Having Jurisdiction ("AHJ") requires. Provisions for supporting other public safety systems (e.g. police); cell phone carriers; tenant's security, maintenance, operations personnel radio system, etc. may be required.

B. Obtain from the local jurisdiction all necessary data about the Emergency Responders existing radio system including frequencies, donor site locations, and effective radiative power ("ERP"),

C. The system shall amplify the Emergency Responders radio signals to achieve a minimum signal strength of -95 dBm in 95% of all areas of the building inclusive of the fire pump house(s).

D. The final system design shall be based upon benchmark test data for the building that is obtained by the contractor after substantial completion of the superstructure (i.e., tilt walls, roof, platforms, and mezzanines).

E. Final acceptance and approval is required from the local AHJ, Owner, and Engineer prior to contract closeout.

1.2 RELATED SECTIONS

A. Section 28 3111 Intelligent, Addressable Fire Alarm System

B. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

C. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term "approved" shall mean Underwriters Laboratories (UL) Listed and/or FM Global (FM) Approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term "Contractor" as used within this specification refers to the electrical and/or fire alarm system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner's and AHJ's minimum design and construction requirements relative to the systems described herein. The

Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 DESIGN-BUILD RESPONSIBILITY

A. The design-build Contractor is responsible for the design, installation, and testing of all systems specified herein so that the final work product is complete and usable to the AHJ and does not interfere with the Owner or Tenants use of the building. The Contractor is responsible to prepare all plans, calculations, and permit applications, to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work.

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code (“NCBC”)
   2. 2018 North Carolina Fire Code (“NCFC”)

B. National Fire Protection Association (NFPA)
   1. NFPA 70 (2014) – National Electric Code (“NFPA 70,” “NEC”)
   2. NFPA 72 (2013) – National Fire Alarm and Signaling Code
   3. NFPA 780 (2014) – Standard for the Installation of Lightning Protection Systems
   4. NFPA 1221 (2019) – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

C. The advisory provisions (Appendices/Annexes) of the above referenced NFPA publications shall be considered to be mandatory, as though the word “shall” had been substituted for “should” wherever it appears.

D. Underwriters Laboratories, Inc. (UL)
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

E. Comply with all other applicable federal, state and local codes and ordinances.

F. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirements shall apply, as determined by the Engineer.

1.7 SYSTEM DESCRIPTION

A. General Requirements
   1. This specification contains performance, design, installation, testing, and servicing requirements for a new Emergency Responder Radio Coverage System, which is to be installed within this facility if the associated testing deems it necessary.
   2. The scope of work includes implementation of the design of the system in accordance with this specification and applicable codes and standards; preparation of appropriate drawings and calculations; submittal of drawings, calculations, equipment data sheets, and bill of materials; installation of the system in accordance with this specification, approved shop submittal, and applicable codes; and completion of final operational tests.

3. Installation shall include the bidirectional amplifier (BDA), donor antenna, distributed antenna system (DAS), coaxial cable, coaxial cable connections, and/or radiating coaxial cable.
4. The backbone, antenna distribution, radiating, or any fiber-optic cables shall be rated as plenum cables.
5. The scope of work includes all necessary configuration of the bidirectional amplifier and all other equipment to make the system fully functional.
6. The scope of work also includes provision of all necessary technical support personnel by the Contractor for completion of interim system inspections and tests as well as thorough acceptance tests by the various approval authorities.
7. The Contractor is responsible for coordination of the installation of all system related equipment with other sub-trades. Where conflicts exist, the Contractor is responsible for making the General Contractor aware of each situation so that the appropriate action may be determined.
8. The Contractor is responsible for identifying all permitting requirements and jurisdiction specific requirements related to the system installation and shall assure that all local requirements have been met with respect to required equipment, specific system functional requirements, etc.
9. All system components must comply with the applicable Federal Communication Commission regulations.

B. Performance Requirements
1. The system shall provide critical areas, such as fire pump room, exit stairs, exit passageway, elevator lobbies, sprinkler control valve locations, and other areas deemed critical by the AHJ, with acceptable two-way radio coverage on not less than 99 percent of each floor area.
2. The system shall provide general building areas with acceptable two-way radio coverage in 95 percent of floor areas.
3. Acceptable radio coverage shall be a minimum of -95dBm and sufficient to provide not less than a Digital Audio Quality (“DAQ”) of 3.0 or better for both inbound and outbound signals.
   a. DAQ is a measure of speech intelligibility of land mobile radios.
   b. DAQ 3.0 is: Speech understandable with slight effort; requires occasional repetition due to noise/distortion.
   c. DAQ 3.4 is: Speech understandable without repetition; some noise/distortion present.
   d. DAQ 4.0 is: speech easily understood; occasional noise/distortion present.
4. If a donor antenna is present, isolation shall be provided between the donor antenna and all inside antennas to maintain a minimum of 20 dB above system gain.

C. Design Requirements
1. All equipment shall be new and unused with a warranty of at least two (2) years from the date of final inspection and acceptance by the approval authorities.
2. The bidirectional amplifier shall be capable of future modification or expansion in the event of frequency changes required by the FCC.
3. Amplification systems shall be by means of a radiating cable system, a distributed antenna system (in accordance with the FCC), or other means as approved by the AHJ, Owner, and Engineer.
4. All repeater, transmitter, receiver, signal booster components, batteries, etc. shall conform to the following requirements.
   a. All components shall be contained in a National Electrical Manufacturer’s Association (NEMA) 4- or 4X-type enclosure.
      1) Batteries that require venting shall be contained in NEMA 3R-type enclosure.

b. Signal booster and emergency battery system shall be supervised and monitored by a supervisory service or approved audible signal at a normally occupied location approved by the AHJ.

5. Equipment shall have certification of the radio licensing authority (e.g., FCC) prior to installation.
6. All technical information and requirements for the system shall be obtained from the AHJ. The minimum technical information to be obtained are the required frequencies, the locations of all radio sites, and the effective power of all radio sites. Other information can be obtained as necessary to provide a complete system.

D. Power Supply Arrangement

The system shall be provided with primary and secondary power supplies. The primary power supply shall be supplied from a dedicated branch circuit and comply with NFPA 72. The secondary power supply shall be capable of operating the system at 100 percent system operation for not less than 12 hours.

E. System Monitoring

The system shall be monitored by the building's fire alarm system. Monitoring for system integrity shall comply with NFPA 72. The monitoring of the system shall include donor antenna malfunction; active RF-emitting device failure; oscillation of active RF-emitting device; low-battery when 70% of the 12-hour capacity has been depleted (i.e., signal at 30% of capacity); active system component failure; power supply, including loss of normal AC power and failure of battery charger (if secondary supply is batteries); and monitoring the integrity of the communication link between the fire alarm system and the emergency responder radio coverage system.

F. Surge Protection

Each AC power circuit shall be provided with a separate transient voltage surge suppression (TVSS) device in accordance with Article 285 of NFPA 70. All low voltage conductors associated with the system passing from the interior to the exterior of the building shall be protected with listed fast-acting TVSS devices.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Submittal Package

1. The Contractor shall prepare a SHOP SUBMITTAL PACKAGE covering the complete system. The SHOP SUBMITTAL PACKAGE shall be submitted to the approval authorities for review and approval. The submittal to the Engineer shall be in an electronic (PDF) format. The SHOP SUBMITTAL PACKAGE shall be approved prior to ordering materials or starting construction. The complete submittal shall conform to all requirements of this section.
2. At the time of completion of the submittal package and prior to transmittal to the approving authorities, the Contractor shall independently perform a quality assurance review of the entire submittal package internally to assure completeness and conformance with all applicable requirements.
3. The SHOP SUBMITTAL PACKAGE shall include the following information:
   a. Complete system shop drawings using AutoCAD (2016 or newer), drawn to scale and showing <u>all</u> system components and functions. Drawings shall also indicate point-to-point wiring to all devices and panels and an

elementary wiring schematic (riser diagram) depicting the actual intended circuit paths and all devices on the system. Drawings shall indicate board level wiring diagrams indicating proper connections inside each panel and subpanel. Drawings shall include antenna numbers, coaxial cable routes, and locations of any other system components including splitters, couplers, filters, amplifiers, etc. Overlay approximate coverage radii indicating downlink signal strength and/or DAQ around each proposed coverage antenna. Include results of any previous coverage testing per grid if available. The drawings shall indicate all wiring, raceway, and electrical box installation requirements as drawing notes for the installers. The drawing scale shall not be less than 1/8 in. = 1 ft.

1) Drawings shall indicate wire counts, type and size of wire or cable used, and the size and type of all conduit and their locations throughout. The location of all junction boxes shall be shown.
2) All drawing submittals shall be submitted on the same size sheets. The drawings shall be sequentially numbered throughout the entire set.

b. Complete battery backup calculations shall be provided.
c. Complete equipment data for all materials and equipment proposed for installation.
d. Installation, operation, programming, and maintenance manuals for all panels and equipment.
e. Complete bill of materials, listing all system components by manufacturer, quantity, and part number, shall accompany the equipment submittal.
f. Complete details of manufacturers' warranties on equipment and Contractor's warranties on installation.
g. Complete manual(s) covering installation, operation, testing, and programming of the BDA.

B. Submittals to the Authorities Having Jurisdiction

Submit shop drawings, product data, and calculations directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities' field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

C. Record Documentation

1. Prepare and maintain on-site throughout the installation of the fire alarm system at least one set of marked-up ("red-lined") drawings which show the system as installed, including deviations from both the project drawings and the approved shop drawings. At least one set of marked-up drawings shall be provided to the Engineer at the time of, or prior to, the final acceptance test and installation review.
2. Prepare and submit record shop drawings and product data, reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted in PDF and AutoCAD formats.
3. Record documentation shall consist of the following:
   a. Record wiring and conduit/wire layout diagrams which indicate wire type, color-code, size, and device interconnection. These drawings shall be drawn to scale and not less than 1/8 in. = 1 ft and shall be produced and submitted in AutoCAD (2016 or newer) format.
   b. Record riser diagrams that indicate the actual installed arrangement of all antennas, radiating coaxial cables, coaxial cables, and other related devices.

c. Original technical literature produced by the manufacturer on all major parts of the system including the bidirectional amplifier, distributed antenna system, and donor antennas.
d. Complete Bill of Materials for the system listing all system components, manufacturer, quantity, and part number.
e. Complete documentation of the manufacturer's warranties on both equipment and installation.
f. All frequencies required by the fire code official.
g. All record documents and related system documentation shall be submitted to the Engineer for review and approval prior to final submittal to the Owner.

1.9 QUALITY ASSURANCE

A. Qualifications
1. The system designer and the lead installation personnel shall hold the following qualifications as a minimum.
   a. A valid FCC-issued general radio operator's license.
   b. Certification of in-building system training issued by a nationally recognized organization, school, or a certificate issued by the manufacturer of the equipment being installed.
2. The system designer and installer shall each have a minimum of three (3) years of continuous experience in the design and/or installation of Emergency Responder Radio Coverage Systems and shall have completed a minimum of 5 projects of similar scope. It is intended that these projects incorporated similar equipment as proposed for this project.
3. Contractor shall have successfully installed Emergency Responder Radio Coverage Systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include the names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.
4. All materials shall be new and in good condition, free of defects, scratches, corrosion, and contamination. Used equipment shall not be allowed.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-listed, FM-approved, and/or FCC Certificated, as required.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the IFC and all required and advisory provisions of NFPA 70, NFPA 72, and NFPA 1221, and all other applicable NFPA standards, Local, State and Federal codes, and all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, manufacturers' product data, and battery and voltage drop calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal's office.
3. Approval of shop drawings, manufacturers' product data, battery calculations, and other materials submitted by the Contractor shall not relieve the Contractor's responsibility for full compliance with this section unless written approval is requested by the Contractor and obtained from the Engineer for the non-complying feature.

4. Deviations from this section and the Contractor's approved submittal documents will not be permitted without written consent from the Engineer.
5. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 72, local, state, or federal requirements, and the requirements of the Authorities Having Jurisdiction.

D. All work shall be performed in a high quality, professional, highly skilled, and timely manner.

1.10 SEQUENCING

A. All work performed shall be carried out in accordance with the applicable sections under Division 1 – General Requirements and shall adhere to the established completion schedule. Every effort shall be made to coordinate the installation with all other trades.

1.11 WARRANTY AND SERVICE AGREEMENT

A. The prime Contractor shall provide, as a part of the installation cost of the system, a warranty and service agreement to cover the installation of the complete system as well as planned and emergency service for a period of two (2) years following final system acceptance by the Owner and Engineer.

B. The warranty and service agreement shall include the following:
1. Labor, parts, and equipment for components placed under warranty.
2. Labor, parts, and equipment to accomplish any manufacturer recommended upgrades or component replacements.
3. Guarantee that all factory issued notifications related to system equipment/ programming upgrades and replacements will be carried out within 14 days of initial notification by the manufacturer.
4. This testing shall include all BDA, amplifiers, distributed antenna, power supplies, back-up batteries, and radiating coaxial cable.
5. Complete written reports covering the test interval shall be submitted to the Owner/ Tenant within five working days of completion of field testing. These reports shall comply with the requirements of NFPA 72.
6. Written information concerning contacting of the fire alarm equipment distributor for normal and emergency service on a 24-hour period with appropriate phone numbers and contacts' names.
7. The Contractor shall guarantee provision of emergency service coverage for the system by properly trained, experienced, and knowledgeable service technicians 24 hours per day, 7 days per week, including all holidays.
8. Written guarantee of maximum call-back time of 1-hour, 4-hour on-site response time for emergency service related to alarm conditions and 12-hour on-site response time related to trouble and supervisory conditions form the initial call.

1.12 EXTRA MATERIALS

A. Provide six (6) keys for each type of enclosure.

B. Provide six (6) of each type of special tool required for system use and maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, available Integrators offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CommScope/Andrew
2. Corning

3. Times Microwave
4. Tessco
5. CCI (Communication Components Inc.)
6. Solid Technologies

2.2 COMPATIBILITY

A. The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.

2.3 WIRING, RACEWAYS AND RELATED MATERIALS

A. All wire and cable of the system shall be listed and shall fully conform to the requirements of the National Electrical Code (NEC) as well as the requirements of the panel and device manufacturers.

B. All conduit, junction boxes, device boxes, terminal cabinets and related hardware and equipment shall be listed and shall fully conform to the requirements of the NEC. All conduit shall be selected such that the maximum fill capacities indicated in the NEC are not exceeded. All device boxes and junction boxes shall similarly be selected such that the fill capacities of these components are within the limits indicated in the NEC. Device mounting boxes must be selected based on proper consideration of the space taken up by the device within the box.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment and shall take any necessary measures to keep the premises clean at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Neither the Engineer nor Owner shall be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. This responsibility rests with the Contractor.

D. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA Codes and Standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean.

E. The Contractor shall install the system devices and equipment in accordance with approved shop drawings.

F. The Contractor is responsible for coordination of system requirements with all conditions of the building and site including, but not limited to, blind spaces, shelving, lights, grilles and diffusers, piping, duct work, doors, windows, equipment platforms, walls (fire-rated and non-fire-rated), beams, joists, columns, HVAC equipment, electrical panels and equipment, ceilings, areas without ceilings, wall construction, floors and all construction, equipment and building appurtenances.

G. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

3.2 WIRING, RACEWAYS AND ELECTRICAL BOXES

A. All AC power or AC control wiring shall be run in EMT conduit in full compliance with the NEC. In no case shall AC power wiring be run in the same conduit as any other circuits. A minimum separation distance of ½ inch between AC power and all other circuits shall be maintained within panels. The exception to this would be at terminal blocks within panels or at the interface with devices. At these locations, maximum possible separation shall be achieved.

B. All wiring and cables shall meet the pathway survivability requirements of NFPA 72.

C. The selection of cable types and wire with respect to conductor size, shielding requirements and separation between circuits shall be in full compliance with the requirements of the manufacturer of the connected equipment without exception.

D. Permanent machine lettered wire markers with numbers/ letters shall be used to identify the terminations of all conductors within the panels and equipment. Permanent wire markers shall also be used at all devices which have numbered terminals. Provide a schedule of numbers on the appropriate drawings.

E. All wires shall be checked for grounds, shorts, opens, and correct resistance, capacitance and other applicable parameters prior to termination of the circuits within panel or subpanels and prior to the installation of devices.

F. Where wiring and conduit penetrate fire-rated barriers, appropriate fire stopping shall be put in place. Installation of materials shall result in fire resistance rating equal to or greater than the rating of the penetrated assembly, unless otherwise indicated.

G. Wherever wiring and cabling pass through building walls, floors and roofs or is exterior to the building, it shall be enclosed in EMT or flexible conduit. Penetrations through exterior walls or roofs shall be sealed weather tight.

H. All junction boxes shall be painted red externally or provided with red covers. Junction box covers shall also be painted red on both sides. The Contractor shall protect building structural elements and interior finishes from being painted. All junction boxes for which the circuit use is not readily discernible shall be permanently labeled. All junction boxes which contain devices shall be labeled. All labels shall consist of engraved phenolic signs which have been approved by the Engineer prior to installation. The use of handwriting to perform this identification is not acceptable.

I. To prevent insulation damage or device damage, the following requirements apply:
   1. Any threaded EMT or flexible conduit terminating at metal boxes or cabinets shall be provided with insulating bushings at throat of connector.
   2. Any EMT connectors must be the all steel compressing type with insulated throats. The exception to this is indenture type which may be used on exposed unfinished areas to obtain a tighter fit to the surface.
   3. Provide a clamp or other approved restraining device where cables or wires which are not in conduit enter junction boxes.

J. All panel enclosures installed in gypsum wallboard walls shall be recess mounted, and interconnecting circuits and shall be concealed within the wall cavity or in the space above the suspended ceiling or other space to the maximum extent possible. All circuits shall be routed and secured in full compliance with the NEC.

3.3 FIELD QUALITY CONTROL AND TESTING

A. The Contractor shall provide a qualified project superintendent for the overall management and supervision of the work.

B. The project superintendent shall assure that adequate supervision is provided during all periods of installation of the fire alarm system. The project superintendent and all job site supervisors shall have a minimum of five years of continuous experience in the installation of fire alarm systems of similar scope and complexity.

C. The system shall be subject to inspection and acceptance by the Authorities Having Jurisdiction and for the purpose of determining that the system is in accordance with federal, state, local, and specification requirements and applicable standards of the NFPA and other related codes.

D. Prior to the system acceptance testing, the Contractor shall provide, in writing, certification that the installed system is in full compliance with the design documents and all applicable codes and standards. See Appendix “A” for a sample letter.

E. The Contractor shall be responsible for performing, documenting, and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification. After completing his testing, the Contractor shall demonstrate full operational capability of the system, as well as full compliance with all design documents, codes and standards, to the AHJ.

F. The Contractor shall perform supplemental tests and shall render additional services in connection with the Emergency Responder Radio Coverage System, as directed, at no additional cost to the Owner. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

G. In the event the acceptance test of the system results in the need for system repair or modification, the Contractor shall demonstrate the operability of the system to the full satisfaction of the Owner and Engineer following the completion of repairs or modification.

H. The Contractor shall conduct an independent quality assurance review of all developed AutoCAD Version (2016 or newer) "record" drawings to assure accuracy and completeness of these drawings. These drawings, as well as the O&M manuals and all other system documentation, shall be turned over to the Owner/Tenant prior to the start of the final acceptance tests.

3.4 MAINTENANCE AND ANNUAL TESTING

A. Annual tests will be conducted by the local Fire Department unit or authorized company.

B. Maintenance Contract

1. Maintenance contract with a Radio Service Provider in place with name of authorized company, who will provide a 24 hour by 7-day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements.
2. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio telephone Operator License, or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the local Fire Department.
3. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.
4. Radio Service Provider maintenance contract shall include but not limited to:
   a. Annual Test
      1) All active components of the distributed antenna system, including but not limited to amplifier, power supplies, and back-up batteries, shall be tested a minimum of once every 12 months.

2) Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.
3) Back-up batteries and power supplies shall be tested under load for a period of one (1) hour to verify that they will operate during an actual power outage.
4) Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.
5) Documentation of the test shall be maintained on site and a copy forwarded to the local Fire Department Radio Supervisor upon completion of the test.

~END OF SECTION~

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Appendix A

Letter of Certification

LETTER OF CERTIFICATION

Building 1
The Industrial Park

To Whom It May Concern:

I certify that XYZ Company has installed, inspected, and tested the fire alarm system in full compliance with all design documents and all applicable codes and standards.

Sincerely,

Max Worker
Manager, Testing and Inspections

Appendix B

Bid Form

Section 26 8115

Emergency Responder Radio Coverage System

Bid Form – Must be filled out completely

ITEM	PART #	EA	QTY	TOTAL
Antenna System				
Fiber (12 strand)				
Coaxial Cable				
Connector				
Coupler				
Splitter				
Inside Antenna *(please list)*				
Donor Antenna *(please list)*				
Donor Antenna Mount				
Miscellaneous Materials				
Equipment				
BDA (please list)				
Alarm Monitor Panel				
Back-Up Power (24 hour)				
NEMA 4/4X Enclosure				
Miscellaneous Materials				
Filters & Combiners				
Filters *(please list)*				
Combiner Network (please list)				
Services				
System Design				
Documentation				
Antenna System Install				
Equipment Install				
Commissioning Tests				
Acceptance				
Other				
Project Total				

SECTION 28 3111

INTELLIGENT, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work covered by this Section:
1. Fire alarm control units
2. Automatic smoke and heat detectors
3. Fire alarm occupant notification devices
4. Auxiliary fire alarm equipment
5. System design, installation, testing, and certification

B. Work not covered by this Section:
1. Provision of sprinkler and fire pump switches to be monitored by the system, including (but not limited to): waterflow switches, tamper switches, fire pump supervisory switches, etc. These switches to be provided by the fire sprinkler contractor.
2. All wiring associated with the telephone line connections to the Digital Alarm Communicator Transmitter (“DACT”).
3. Provision of monitoring services by a UL-listed Central Station.

1.2 RELATED SECTIONS

A. Section 21 1313 Wet Pipe Fire Sprinkler Systems

B. Section 21 1317 Preaction Fire Sprinkler System

C. Section 21 3113 Diesel Driven, Centrifugal Fire Pump

D. Section 21 4123 Ground Suction Water Storage Tanks for Fire Protection

E. Section 26 8115 Emergency Responder Radio Coverage System

F. The conditions of the Contract, including the General Conditions and Supplementary Conditions, and Division 1 - General Requirements, apply to work covered by this Section.

G. Comply with Mechanical, Electrical and Civil Division Sections, as applicable. Refer to other Divisions for coordination of work.

1.3 DEFINITIONS

A. Equipment and materials shall be approved for their designed use and performance. The term “approved” shall mean Underwriters Laboratories (“UL”) Listed and/or FM Global (“FM”) Approved and/or acceptable to the approval authorities.

B. Approval authorities shall include the Owner, authorized representative Harrington Group, Inc. (Engineer), insurance provider, the General Contractor, and the local fire/code official(s), where applicable, (Authorities Having Jurisdiction).

C. The term “Contractor” as used within this specification refers to the electrical and/or fire alarm system subcontractor(s).

1.4 INTENT

A. It is the intent of this specification section to provide the Owner's minimum design and construction requirements relative to the fire protection systems described herein. The Contractor shall comply with the provisions of this section to the maximum extent possible while still complying with the provisions of the local codes and standards.

B. It is not the intent of this specification to provide complete design and construction requirements as may be stipulated by the applicable building and fire codes enforced in the local jurisdiction. The responsibility to identify and comply with all provisions of the local building and fire codes, including all applicable standards, rests with the design-build Contractor.

1.5 CONTRACTOR RESPONSIBILITY

A. The Contractor is responsible for the design, installation, and testing of all fire protection systems specified herein so that the final work product is complete and usable to the Owner and Tenant. The Contractor is responsible to prepare all plans, calculations, and permit applications, to affix all required certifications and seals, to pay all required fees, and to perform all other work necessary to secure a construction permit and to obtain final approval of the work. This engineered design includes a performance-based design approach. The Contractor shall comply with project criteria drawings and specifications. The project is not design-build. The Contractor is not authorized to deviate from the project drawings and/or specifications without express written approval through a Request for Information or other contractual mechanism.

1.6 REFERENCES

A. State of North Carolina
   1. 2018 North Carolina Building Code ("NCBC")
   2. 2018 North Carolina Fire Code ("NCFC")

B. National Fire Protection Association ("NFPA")
   1. NFPA 13 (2013) – Standard for the Installation of Sprinkler Systems ("NFPA 13")
   2. NFPA 20 (2013) – Standard for the Installation of Stationary Pumps for Fire Protection ("NFPA 20")
   3. NFPA 22 (2013) – Standard for Water Tanks for Private Fire Protection ("NFPA 22")
   4. NFPA 70® (2014) – National Electrical Code® ("NFPA 70")
   5. NFPA 72® (2013) – National Fire Alarm and Signaling Code® ("NFPA 72")

C. The advisory provisions (Appendices/Annexes) of the above referenced NFPA publications shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

D. Underwriters Laboratories, Inc. ("UL")
   1. Fire Protection Equipment Directory (most current edition including supplements)
   2. Building Materials Directory (most current edition including supplements)
   3. Electrical Construction Materials Directory (most current edition including supplements)

E. FM Global ("FM")
   1. FM Global Research Approval Guide (most current edition including supplements)

F. Comply with all other applicable federal, state and local codes and ordinances.

G. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirements shall apply, as determined by the Engineer.

1.7 SYSTEM DESCRIPTION

A. General Requirements

1. This specification contains performance, design, installation, testing, and servicing requirements for a new fire alarm signaling system, which is to be installed within this facility.
2. The scope of work includes implementation of the design of the system in accordance with this specification and applicable codes; preparation of appropriate drawings and calculations; submittal of drawings, calculations, equipment data sheets, and bill of materials; installation of the system in accordance with this specification, approved shop submittal, and applicable codes; and completion of final operational tests.
3. Installation shall include the fire alarm control unit ("FACU"), notification appliance circuit auxiliary power supplies, remote annunciator panels, initiating devices, notification appliances, monitor modules, control modules, supplemental relays, low voltage and high voltage wiring and raceways, surge suppressors, and digital alarm communicator transmitter ("DACT").
4. The scope of work includes all necessary programming of the FACU and DACT by the Contractor. All revisions to these programs which are required by the approval authorities, up to the point of final acceptance of the complete system by all approval authorities are to be carried out by the Contractor at no additional expense to the Owner and/or Tenant.
5. The scope of work also includes provision of all necessary technical support personnel by the Contractor for completion of interim system inspections and tests as well as thorough acceptance tests by the various approval authorities.
6. The Contractor is responsible for coordination of the installation of all system related equipment with other subtrades. Where conflicts exist, the Contractor is responsible for making the General Contractor aware of each situation so that the appropriate action may be determined.
7. The Contractor is responsible for identifying all permitting requirements and jurisdiction specific requirements related to the system installation and shall assure that all local requirements have been met with respect to required equipment, specific system functional requirements, etc.

B. Performance Requirements

1. The fire alarm system shall respond to various system inputs as indicated on the Fire Alarm Sequence of Operations Matrix on the fire protection drawings.
2. All ALARM signals shall latch and shall not release until the system is manually reset at the FACU or an annunciator panel. All other signals (SUPERVISORY or TROUBLE) shall be self-restoring upon correction of the off-normal condition unless otherwise indicated on the Fire Alarm Sequence of Operations Matrix.

C. Design Requirements

1. The new system shall be a fully field programmable, BACnet enabled, microprocessor-based addressable system capable of two-way communication over signaling line circuits between intelligent/analog addressable initiating devices or addressable interfacing/control modules and the fire alarm control unit.
2. In addition to remote supervising station(s), the fire alarm system shall be monitored by the Building Management System.
3. All equipment shall be new and unused with a warranty of at least one year from the date of final inspection and acceptance by the approval authorities.
4. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. All components of the system shall be UL-listed and/or FM-approved, and compatibility of all system components shall be verified.
5. The FACU and DACT shall be provided to monitor all initiating devices, including waterflow and valve tamper switches for all fire sprinkler systems, fire pump related

valve tamper switches, fire pump supervisory signals, manual pull stations, spot and duct smoke detectors, water storage tank-associated signals, emergency responder radio coverage system, and all other initiating devices indicated on the fire protection drawings and specifications.

6. The system shall provide a distinct evacuation signal using horn/strobes, horns, and strobes as indicated by the design intent illustrated on the fire alarm drawings. The system shall be arranged such that the evacuation signals are activated according to the Fire Alarm Sequence of Operations Matrix indicated on the drawings. All strobes shall be synchronized to operate simultaneously in accordance with NFPA 72.
7. The fire alarm control unit shall allow for loading or editing special instructions and operating sequences as required. The system is to be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. The substitution of EEPROMS or other electronic memory chips shall not be required for any programming changes related to system modification or expansion. All software operations are to 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. The Owner/Tenant shall be provided with both a written and an electronic copy of the complete program for the system.
8. The ability for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations is to also be incorporated in the resident software programming of the system.
9. The FACU and DACT shall be located in the fire pump room, as indicated on the fire protection drawings.
10. Full-function remote annunciator panels with LCD display and the capability to acknowledge, silence, and reset all alarm, supervisory, or trouble conditions shall be provided and located near the Main Security Desk, as indicated on the fire protection drawings. Coordinate the exact location of the equipment with the tenant.
11. Selection of cable types and wire with respect to conductor size, shielding requirements, and separation between circuits shall be in full compliance with the requirements of the manufacturer of the FACU and the DACT, without exception. All circuit wire/cable shall be specifically listed for use with fire alarm systems.
12. To accommodate and facilitate job site changes, all circuits shall be individually configurable on-site.
13. The FACU shall be designed for future expansion and modification. In no case shall circuit, battery, and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
14. All subpanels, such as notification applicable circuit power extender panels (NAC Panels), shall be designed for future expansion and modification. In no case shall circuit, battery, and/or module loading exceed eighty (80) percent of the design capacity as specified by the manufacturer.
15. The FACU shall monitor the building fire pump and associated components/ conditions, as indicated on the fire protection drawings.
16. The FACU shall monitor the MDF Room's preaction sprinkler system's Releasing Service Fire Alarm Control Unit ("RSFACU") conditions, as indicated on the fire protection drawings. The RSFACU is the responsibility of the Contractor.
17. All alarm and supervisory devices shall be monitored as separate and distinct alarm points using separate monitor modules as needed.
18. All initiating device circuits shall be arranged as Class B.
19. All notification appliance circuits shall be arranged as Class B.
20. All signaling line circuits shall be arranged as Class A.

D. Primary Power Supply Arrangement

Power to the FACU, DACT, and NAC Panels shall be supplied from individual, dedicated AC power circuits, which serve no other loads. Each circuit shall be equipped with a separate breaker, which is properly sized and identified per NFPA 70 and NFPA 72. Each circuit breaker shall be red marked and mechanically locked to prevent unauthorized operation.

E. Surge-Protective Devices
Each AC power circuit shall be provided with a separate surge-protective device (i.e., transient voltage surge suppression [“TVSS”]) device in accordance with Article 285 of NFPA 70. All power conductors associated with the system passing from the interior to the exterior of a structure shall be protected with listed fast-acting TVSS devices.

1.8 SUBMITTALS

Only complete submittal packages, which include all required drawings, calculations, and product data sheets, shall be submitted for approval. Partial submittal packages may be returned to sender without being reviewed.

A. Shop Submittal Package
1. The Contractor shall prepare a SHOP SUBMITTAL PACKAGE covering the complete system. The SHOP SUBMITTAL PACKAGE shall be submitted to the approval authorities for review and approval. The submittal to the Engineer shall be in an electronic (PDF) format. The SHOP SUBMITTAL PACKAGE shall be approved prior to ordering materials or starting construction. The complete submittal shall conform to all requirements of this section.
2. At the time of completion of the submittal package and prior to transmittal to the approving authorities, the Contractor shall independently perform a quality assurance review of the entire submittal package internally to assure completeness and conformance with the specifications and design drawings. The Contractor shall use the submittal checklist in Appendix “A” of this section to accomplish this review. The completed checklist shall be submitted with the SHOP SUBMITTAL PACKAGE.
3. The SHOP SUBMITTAL PACKAGE shall include the following information:
a. Complete system shop drawings using AutoCAD (2016 or newer), drawn to scale and showing all system components and functions, including FACU, DACT, initiating devices, addressable modules, relay modules, surge suppressors, interlocks, etc. Drawings shall also indicate point-to-point wiring to all devices and panels and an elementary wiring schematic (riser diagram) depicting the actual intended circuit paths and all devices on the system. Drawings shall indicate board level wiring diagrams indicating proper connections inside each panel and subpanel. Drawings shall indicate individual addresses of each addressable point at each device. Drawings shall indicate a listing of the proposed point descriptions (each point) for approval. The drawings shall indicate all wiring, raceway, and electrical box installation requirements from paragraph 3.2 as drawing notes for the installers. The drawing scale shall not be less than 1/8 in. = 1 ft.
1) Drawings shall indicate wire counts, type and size of wire or cable used, and the size and type of all conduit and their locations throughout. The location of all junction boxes shall be shown. Comply with Appendix “C” for tables indicating cross-sectional area of all wire and cable to be used in the planned combination vs. conduit size, including cross-sectional area.
2) All drawing submittals shall be submitted on the same size sheets. The drawings shall be sequentially numbered throughout the entire set.

b. Complete battery backup calculations and voltage drop calculations. Battery back-up calculations shall be performed in conformance with NFPA 72 for the FACU, and DACT. Ampere-hour requirements for each system component shall be submitted with the calculations. Voltage drop calculations shall utilize a starting voltage of 20.4 VDC.
c. Complete equipment data for all materials and equipment proposed for installation.
d. Installation, operation, and programming manuals for all panels and equipment.
e. Complete bill of materials, listing all system components by manufacturer, quantity, and part number, shall accompany the equipment submittal.
f. Complete details of manufacturers' warranties on equipment and Contractor's warranties on installation.
g. Complete manual(s) covering installation, operation, testing, and programming of the FACU and DACT.

B. Submittals to the Authorities Having Jurisdiction

Submit shop drawings, product data, and calculations directly to the Authorities Having Jurisdiction for approval. Do not commence work until approval is obtained. Provide proof of approval to Owner. Coordinate with the local authorities' field inspecting representatives and make all adjustments or changes required to obtain approval without added cost to the contract.

C. Record Documentation
1. Prepare and maintain on-site throughout the installation of the fire alarm system at least one set of marked-up ("red-lined") drawings which show the system as installed, including deviations from both the project drawings and the approved shop drawings. At least one set of marked-up drawings shall be provided to the Engineer at the time of, or prior to, the final acceptance test and installation review.
2. Prepare and submit record shop drawings, product data, and hydraulic calculations reflecting final as-built conditions at completion of project, but before final acceptance of the work. These documents shall be prepared in accordance with the requirements for the initial submittal. Freehand sketches or mark-up documents are not acceptable. Record drawings shall be submitted on electronic media (CD or DVD) in PDF and AutoCAD formats.
3. Record documentation shall consist of the following:
a. Record wiring and conduit/wire layout diagrams which indicate wire type, color-code, size, and device interconnection. These drawings shall be drawn to scale and not less than 1/8 in. = 1 ft and shall be produced and submitted in AutoCAD (2016 or newer) format.
b. Record elementary (including board level) wiring diagrams of the FACU, DACT, modules, and circuit interconnections.
c. Record riser diagrams that indicate the actual installed arrangement of all initiating, notification, and signaling circuits and auxiliary devices.
d. Record device location drawings with device numbers provided for all initiating, notification and control devices. Final selected power tap settings on all notification devices shall be indicated. The location of all junction boxes shall be shown.
e. Original technical literature produced by the manufacturer on all major parts of the system including control panel, DACT, modules, initiating and notification devices, power supplies, switches, and auxiliary controls.
f. Complete battery backup power calculations, performed in conformance with NFPA 72 for the FACU, fire alarm control units, and automatic transmitters, and final voltage drop calculations for all notification device circuits.

g. Complete Bill of Materials for the system listing all system components, manufacturer, quantity, and part number.
h. Complete documentation of the manufacturer's warranties on both equipment and installation.
i. Complete printout of the FACU programming.

4. All record documents and related system documentation shall be submitted to the Engineer for review and approval prior to final submittal to the Owner.

D. Contractor’s Record of Inspection and Testing

Upon completion of required inspection and testing, submit completed and signed Fire Alarm and Emergency Communication System Inspection and Testing Form, in accordance with NFPA 72 requirements, certifying systems meet or exceed the specified requirements.

1.9 QUALITY ASSURANCE

A. Qualifications

1. The fire alarm equipment distributor and installer shall be competent firms which are regularly engaged in the design, installation, testing, and servicing of fire alarm systems for commercial buildings.
2. Contractor shall be certified by the material/equipment manufacturer as trained in, and as knowledgeable of, the manufacturer's standard practices and procedures relating to installation of sprinkler systems. The Contractor shall be certified and licensed by the state and local jurisdictions, as applicable.
3. Contractor shall utilize the services of a fire alarm equipment distributor (when applicable) which is a factory authorized representative and a stocking distributor of the equipment manufacturer and shall maintain a constant inventory of the parts typical of those used in the system installation covered under this specification. This distributor shall be located within 125 miles of the project site.
4. The fire alarm equipment distributor and installer shall each have a minimum of three (3) years of continuous experience in the design and/or installation of fire alarm systems and shall have completed a minimum of 5 projects of similar scope. It is intended that these projects incorporated similar equipment as proposed for this project.
5. Contractor shall have successfully installed fire alarm systems of the same type and design as specified herein. The Contractor shall provide evidence of such qualifications. The data shall include the names and locations of at least three installations where the Contractor has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. The Contractor shall be certified by the State as a fire alarm installer and shall provide a copy of certification.
6. All materials shall be new and in good condition, free of defects, scratches, corrosion, and contamination. Used equipment shall not be allowed.

B. Equipment and components shall bear the markings indicating the equipment or component is UL-listed and/or FM-approved. The following UL standards and subcategories are applicable:

1. UL 268 Smoke Detectors for Fire Protective Signaling Systems (UROX), (URRQ).
2. UL 268A Smoke Detectors for Duct Applications (UROX), (URRQ).
3. UL 38 Manually Actuated Signaling Boxes for Use with Protection Signaling Systems (UNIU).
4. UL 464 Audible Signal Appliances (ULSZ), (UUMW).
5. UL 521 Heat Detectors for Fire Protective Signaling Systems (UQGS).
6. UL 864 Control Units for Fire Protective Signaling Systems – Ninth Edition (UOJZ), (UOQY), (UOXX), (UUKL).

7. UL 1971 Signaling Devices for the Hearing Impaired.

C. Regulatory Requirements
1. The design, equipment, materials, installation, and workmanship shall be in strict accordance with the required and advisory provisions of NFPA 70 and NFPA 72, to other applicable NFPA standards, to all Local, State and Federal codes, and to all other requirements specified herein. The advisory provisions (Appendices/ Annexes) of the NFPA publications referred to herein, shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. If there are any conflicts between these specifications and the referenced standards and publications, the most stringent requirement shall apply, as determined by the Engineer.
2. Shop drawings, manufacturers' product data, and battery and voltage drop calculations shall bear the stamp of approval of Authorities Having Jurisdiction, including the Engineer and the Fire Marshal's office.
3. Approval of shop drawings, manufacturers' product data, battery and voltage drop calculations, and other materials submitted by the Contractor shall not relieve the Contractor's responsibility for full compliance with the design drawings and specifications unless written approval is requested by the Contractor and obtained from the Engineer for the non-complying feature.
4. Deviations from the contract documents and the Contractor's approved submittal documents will not be permitted without written consent from the Engineer.
5. Compliance with the contract documents shall not relieve the Contractor from any specification section including strict compliance with NFPA 72, local, state, or federal requirements, and the requirements of the Authorities Having Jurisdiction.
6. All work shall be performed in a high quality, professional, highly skilled, and timely manner.

1.10 SEQUENCING

A. All work performed shall be carried out in accordance with the applicable sections under Division 1 – General Requirements and shall adhere to the established completion schedule. Every effort shall be made to coordinate the installation of the fire alarm system with all other trades.

1.11 WARRANTY AND SERVICE AGREEMENT

A. The prime Contractor shall provide, as a part of the installation cost of this fire alarm system, a warranty and service agreement to cover the installation of the complete system as well as planned and emergency service for a period of one year following final system acceptance by the Owner and Engineer.

B. The warranty and service agreement shall include the following:
1. Labor, parts, and equipment for components placed under warranty.
2. Labor, parts, and equipment to accomplish any manufacturer recommended upgrades or component replacements.
3. Guarantee that all factory issued notifications related to system equipment/ programming upgrades and replacements will be carried out within 14 days of initial notification by the manufacturer.
4. During the warranty period, the fire alarm equipment distributor shall periodically perform complete inspections of the system including recommended tests and maintenance in accordance with the manufacturer's instructions and all applicable NFPA codes and standards.
5. This testing shall include all manual pull stations, detection devices, annunciators, control equipment, auxiliary equipment, notification circuits, and individual notification devices.

6. The fire alarm equipment distributor shall provide a written record of all sensitivity settings of system smoke detectors on a six-month frequency. The distributor is responsible for monitoring the drift or cleanliness level of the detectors based on sensitivity measurements and for taking appropriate action to prevent false alarms from occurring.
7. Complete written reports covering the test interval shall be submitted to the Owner/ Tenant within five working days of completion of field testing. These reports shall comply with the requirements of NFPA 72.
8. Written information concerning contacting of the fire alarm equipment distributor for normal and emergency service on a 24-hour period with appropriate phone numbers and contacts' names.
9. The Contractor shall guarantee provision of emergency service coverage for the system by properly trained, experienced, and knowledgeable service technicians 24 hours per day, 7 days per week, including all holidays.
10. Written guarantee of maximum call-back time of 1-hour, 4-hour on-site response time for emergency service related to alarm conditions and 12-hour on-site response time related to trouble and supervisory conditions form the initial call.
11. Provision for two (2) major programming changes and ten (10) minor programming changes at the option of the Owner/ Tenant during the warranty period at different times selected by the Owner/ Tenant. Major programming changes involve address changes, message changes, function changes, or other similar changes to fifteen (15) or more devices. Minor programming changes involve less than fifteen (15) devices.
12. Unit Price: The fire alarm contractor shall provide a unit price in accordance with the following:
    a. Within 30 days of the end of the warranty period, the fire alarm equipment distributor shall clean all devices, test and re-certify the fire alarm system, and provide a written report as stated elsewhere in this section. This testing shall include measurement/ verification of the sensitivity level of the system smoke detectors, with a complete sensitivity report included as part of the system testing documentation.
    b. This unit price is not part of the base bid.
    c. This unit price shall be initiated at the Owner's option.

1.12 EXTRA MATERIALS

A. Provide six (6) keys for each type of enclosure.

B. Provide one (1) of each type of automatic detector.

C. Provide one (1) of each type of monitor module, control module, and notification device installed.

D. Provide six (6) of each type of special tool required for system use and maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide a complete fire alarm system as indicated with all components manufactured by a single manufacturer to the extent possible. Acceptable manufacturers shall be Notifier or Edwards/EST. All equipment supplied under this specification shall be new, UL-listed and/or FM-approved for fire protection and have been verified to be compatible with the other components of the system.

2.2 FIRE ALARM CONTROL UNIT

A. The FACU shall be readily accessible and shall conform to the requirements of NFPA 72 for a local and Central Station protective signaling system. The complete assembly shall be UL-listed under the Ninth Edition of UL 864. The fire alarm panel enclosure shall be NEMA 2 rated and shall be equipped with a hinged cover and key-operated latch.

B. The FACU shall be approved for supervision of intelligent/addressable initiating devices through a microprocessor using digital protocol/ response protocol technology.

C. The FACU shall be fully field programmable using any compatible laptop computer. The FACU shall be capable of operating a minimum of one (1) printer, and three (3) remote liquid crystal display annunciators over standard RS-232-C interfaces. Level 1 programming changes shall be capable of being made by the Owner without the need for a laptop computer.

D. The FACU shall contain an alphanumeric system status display of at least 80 characters, which can be viewed without opening the FACU front cover. This display shall be field programmable and capable of automatically displaying device address number, device type, status of alarm or trouble and Owner designated message. It shall be possible to step through the current alarm or trouble indications through the use of a keypad on the control panel.

E. The FACU shall be capable of reading and recording the true sensitivity level of all intelligent/analog smoke detectors, including duct-type detectors. The control panel shall be specifically listed under UL 864 to perform this function from the panel. It shall not be necessary to perform any degree of testing at the individual detection devices in order to conform to the UL listing. The control panel shall also incorporate a walk-test feature to facilitate testing of the system and a minimum 800 event history buffer.

F. The FACU shall be capable of alarm verification on a per device basis. The main panel and all subpanels shall be modular in construction and designed to receive plug-in component boards to accomplish the various system functions described in this specification. The FACU shall have alarm and trouble silence switches with a subsequent alarm and trouble receiving feature. Silencing of audible notification signals shall not affect the operation of controlled relays or annunciators.

G. All AC power connections shall be hardwired on individual dedicated branch circuits, which serve no other loads. The circuit panels chosen for the dedicated branch circuits shall not include other circuits which supply motor related loads greater than 1 horsepower. The circuit and connections shall be mechanically protected within approved electrical enclosures, conduits or raceways. The power circuit disconnecting means shall be clearly labeled “Fire Alarm System Power – [location].” The disconnecting means shall be located in a locked enclosure, which is accessible only to authorized personnel.

H. Normal backup power to the FACU and the DACT shall be provided with 24 VDC battery back-up which is sized to operate the complete system on standby for 24 hours. Following this 24-hour period, the batteries shall be capable of operating the system under alarm conditions for a period of five (5) minutes.

I. The FACU and DACT shall be equipped with integral battery chargers which automatically keep the batteries fully charged. Wires, which lead from the backup battery terminals, shall be fully supervised for open and short circuit conditions.

J. The FACU and DACT shall automatically switch to back-up battery power in the event that the incoming power level drops to eighty (80) percent of rated voltage. All system functions including detection, supervision, annunciation, alarm retransmission, evacuation signaling, and control functions shall operate <u>identically</u> on either primary or back-up power.

K. The FACU, auxiliary devices, and all electronic components shall be designed and installed such that no spurious signals or operations occur within the system, which are the result of radio/cellular phone transmissions. The system shall not be adversely affected by either a five (5) Watt hand-held two-way radio or a one-half (1/2) Watt cellular telephone being operated within 12 in. of any system panel or device.

L. The FACU shall each be protected by a UL-listed fast acting electrical transient surge suppressor which incorporates low Z earth grounding. The surge suppressor shall be UL 1449 listed with a 330-volt suppression level and shall have a maximum response time of 5 nanoseconds. The device shall meet IEEE CG2.41 Category B tests for surge capacity. The device shall feature multi-stage construction which includes inductors and silicon avalanche zener diodes. The devices shall be housed in a metal enclosure with a hinged, latching door, or a removable cover. Each enclosure shall be located adjacent to the associated panel being supplied.

2.3 REMOTE ANNUNCIATOR PANEL

A. Remote annunciator panels shall include an 80-character LCD display to mimic the FACU display. The device shall be equipped with backlighting, and control switches for system acknowledge, signal silence, and system reset. The remote annunciator shall be capable of flush or surface mount.

B. The remote annunciator shall be equipped with a piezo sounder with alarm/trouble resound.

2.4 NOTIFICATION APPLIANCE POWER EXTENDER PANELS

A. Power extender panels for notification appliance circuits shall be no less than 10-amp power supplies with NAC output circuits capable of being configured as four (4) Class B circuits. Each power-limited supervised notification appliance circuit shall be capable of 24 VDC and no less than 3.0 amps.

B. The NAC Panels shall each be protected by a UL-listed fast acting electrical transient surge suppressor which incorporates low Z earth grounding. The surge suppressor shall be UL 1449 listed with a 330-volt suppression level and shall have a maximum response time of 5 nanoseconds. The device shall meet IEEE CG2.41 Category B tests for surge capacity. The device shall feature multi-stage construction which includes inductors and silicon avalanche zener diodes. The devices shall be housed in a metal enclosure with a hinged, latching door, or a removable cover. Each enclosure shall be located adjacent to the associated panel being supplied.

2.5 ADDRESSABLE MONITOR MODULES

A. Monitor modules shall be capable of monitoring normally open contact initiating device circuits and shall be equipped with LED status indicator light and high noise immunity.

2.6 ADDRESSABLE CONTROL MODULES

A. Control modules shall be capable of providing a single notification appliance circuit or Form-C relay contacts for air handler unit shutdown or other control functions and shall be equipped with integral LED status light indicator and high noise immunity.

B. The individual control modules should be arranged such that they are controlled from the intelligent loop and remain activated until the fire alarm control unit has been reset.

C. The individual control modules shall be controllable based on programming of any number of initiating devices selected.

2.7 AUXILIARY DEVICES

A. The DACT shall be compatible with the FACU. The DACT may be an integral part of the FACU or may be a separate panel. If separate, it shall be enclosed within a separate metal enclosure equipped with a hinged lockable front, which is provided by the manufacturer for specific use with the DACT model provided. The DACT enclosure shall carry a NEMA 2 rating.

B. The DACT shall have the capability of transmitting all alarm, trouble, and supervisory signals, by address, to the alarm receiving station (i.e., each waterflow, each detector, etc. shall be a separate signal received at the alarm receiving station). The DACT shall be arranged for dual phase line operation with built-in phase monitor and shall be capable of automatically generating a 24-hour test.

C. The DACTU shall each be protected by a UL-listed fast acting electrical transient surge suppressor which incorporates low Z earth grounding. The surge suppressor shall be UL 1449 listed with a 330-volt suppression level and shall have a maximum response time of 5 nanoseconds. The device shall meet IEEE CG2.41 Category B tests for surge capacity. The device shall feature multi-stage construction which includes inductors and silicon avalanche zener diodes. The devices shall be housed in a metal enclosure with a hinged, latching door, or a removable cover. Each enclosure shall be located adjacent to the associated panel being supplied.

2.8 WIRING, RACEWAYS AND RELATED MATERIALS

A. All wire and cable of the system shall be listed and shall fully conform to the requirements of the NFPA 70 as well as the requirements of the panel manufacturers.

B. All conduit, junction boxes, device boxes, terminal cabinets and related hardware and equipment shall be listed and shall fully conform to the requirements of the NFPA 70. All conduit shall be selected such that the maximum fill capacities indicated in the NFPA 70 are not exceeded. All device boxes and junction boxes shall similarly be selected such that the fill capacities of these components are within the limits indicated in the NFPA 70. Device mounting boxes must be selected based on proper consideration of the space taken up by the device within the box. Refer to Appendix “C” at the end of this specification.

2.9 SMOKE DETECTORS

A. Smoke detectors shall be photoelectric, analog, addressable spot-type devices. The detectors shall be a plug-in unit that mounts to a twist-lock base. The detector shall incorporate an LED to indicate both normal operation (pulsed light) and alarm activation (steady light).

B. The sensitivity of the individual detectors shall be readily determinable through the fire alarm control unit. The sensitivity setting of the individual detectors shall also be adjustable through the control panel.

C. The detectors shall fit into a base that is common with both photoelectric and thermal detectors and shall be compatible with other addressable detectors, addressable manual stations, and addressable interface/control modules on the same circuit.

D. There shall be no limit on the number of sensors, stations or interface control modules, which may be activated, or in alarm simultaneously.

2.10 HVAC DUCT DETECTORS

A. Duct detectors shall be analog/addressable or conventional, photoelectric, spot-type devices in accordance with the fire protection drawings. The positioning of the duct detector

shall be carefully chosen to assure optimum performance of the detector. The detector shall incorporate an LED to indicate both normal operation (pulsed light) and alarm activation (steady light).

B. Differential pressure measurements shall be taken and recorded by the Contractor to assure compliance with the manufacturer's requirements. The detector shall incorporate sample tubes which are both selected and installed in full conformance with the manufacturer's requirements.

C. The detector shall be the plug-in type with a twist-lock base. The sensitivity of the individual detectors shall be readily determinable through the fire alarm control unit. The sensitivity setting of the individual detectors shall also be adjustable through the control panel.

D. There shall be no limit to the number of sensors, stations or interface control modules, which may be activated, or in alarm simultaneously.

2.11 MANUAL STATIONS

A. Manual stations shall be single action, addressable type. The manual station shall be installed as indicated on the fire protection drawings and listed to UL 38.

B. All manual pull stations shall have fire alarm pull covers. The fire alarm contractor shall be responsible for verifying that the cover chosen is compatible with the respective pull station. The STI-1130 cover shall be used, where possible.

2.12 NOTIFICATION DEVICES

A. Horn/strobe, strobe-only, and/or horn-only device(s) shall be installed where indicated on the fire alarm drawings. The devices shall be listed to UL 1971 and UL 464 and shall be weatherproof type suitable for mounting on an exterior wall when indicated on the fire alarm drawings.
   1. Devices shall be mounted to permanent building structure or walls in accordance with the manufacturers' listing and installation instructions.
   2. Devices shall not be directly supported from pallet racking or other building equipment without explicit permission from the engineer of record.

2.13 KEYED SWITCHES

A. Keyed switches shall be UL listed fire alarm control unit accessories (S735) compatible with the provided FACU. Keyed switches shall be addressable with LED status indicator. Keyed switches shall be capable of being mounted in single gang back box.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate work of this Section with other affected work.

B. The Contractor shall take any necessary measures to prevent damage to the facilities and equipment and shall take any necessary measures to keep the premises clean at all times. Damage resulting from the work and testing under this section, whether intentional or not, shall be repaired by the Contractor at no cost to the Owner.

C. Neither the Engineer nor Owner shall be responsible for providing a safe working place for the Contractor, subcontractors, or their employees, or any individual responsible to them for the work. This responsibility rests with the Contractor.

D. All equipment shall be installed in an aesthetic and skilled manner in accordance with NFPA Codes and Standards and other applicable standards referenced by this document. Final appearance of all systems and equipment shall be neat and clean.

E. The Contractor shall install the system devices and equipment in accordance with approved shop drawings.

F. The Contractor is responsible for coordination of system requirements with all conditions of the building and site including, but not limited to, blind spaces, shelving, lights, grilles and diffusers, piping, duct work, doors, windows, equipment platforms, walls (fire-rated and non-fire-rated), beams, joists, columns, HVAC equipment, electrical panels and equipment, ceilings, areas without ceilings, wall construction, floors and all construction, equipment and building appurtenances.

G. Equipment, devices, apparatus, and accessories requiring normal servicing, operation and maintenance shall be made easily accessible.

H. The fire alarm contractor shall wire any duct detectors installed by the mechanical contractor.

I. The fire alarm contractor shall wire up to AHU or RTU shutdown control modules; mechanical/electrical contractor shall wire control modules to AHU or RTU control circuits.

J. The Contractor is responsible for achieving the required audibility as indicated on the drawings. The indicated horn/ strobe layout on the drawings is intended to indicate the minimum acceptable visible notification.

3.2 WIRING, RACEWAYS AND ELECTRICAL BOXES

A. All AC power or AC control wiring shall be run in EMT conduit in full compliance with NFPA 70. In no case shall AC power wiring be run in the same conduit as any other fire alarm circuits. A minimum separation distance of ½-in. between AC power or control wiring and all circuits shall be maintained within the FACU, DACT, and all other fire alarm interfaces. The exception to this would be at terminal blocks within panels or at the interface with devices. At these locations, maximum possible separation shall be achieved.

B. All wiring/cables shall be run in EMT conduit up to the elevation of the bottom member of the bar joist or roof structure member. The conduit shall be bent 90° at the top of all conduit risers so as to terminate horizontally at the bottom member. All wiring/cables shall be neatly routed and fastened in full conformance with the requirement of NFPA 70 and configured so that the structural members protect the wiring from mechanical damage. All wiring/cables which are not in conduit shall be supported by building structural members for the full running length of the wire or cable. “Stringing” cable across the bottom members of the structure will not be permitted.

C. The selection of cable types and wire with respect to conductor size, shielding requirements and separation between circuits shall be in full compliance with the requirements of the manufacturer of the fire alarm panels without exception. Voltage drop calculations shall be submitted for the notification circuits of the system. All initiating, signaling, and notification circuit wire/cable shall be specifically listed for use with fire alarm systems. In the event that performance testing indicates that conductor performance or separation is inadequate, the Contractor shall make all necessary corrections without expense to the Owner.

D. The selection of conductors shall fully comply with the National Electrical Code, Articles 725 and 760. The stranding restrictions of individual conductors shall be complied with without exception. All wiring shall be specifically listed for fire alarm system application.

Samples of all cable and wire to be utilized in the installation shall be submitted to the Engineer for approval prior to usage.

E. Permanent machine lettered wire markers with numbers/ letters shall be used to identify the terminations of all conductors within the FACU and the DACT. Permanent wire markers shall also be used at all devices which have numbered terminals. Provide a schedule of numbers on the appropriate drawings.

F. In no case shall conductors be joined by splicing. Appropriate lugs and terminal blocks, or pressure connectors shall be used where conductors are joined. Wire nuts shall not be used. All terminal blocks shall be either the fully insulated, floating type, or be permanently mounted to appropriate metal enclosures using metal screws. Use of adhesive strips or similar means to mount terminal blocks is prohibited. All connections to the fire alarm control unit terminal blocks, as well as all connections to screw terminals of devices, shall be completed with properly sized and crimped lugs if stranded wire is utilized. In all cases where end-of-line resistors share a terminal block connection with another conductor, the leads of the resistor shall be within two AWG sizes of the other conductor without exception.

G. In all cases where shielded cable is used, the shielding shall be maintained continuously throughout the circuit and shall terminate to appropriate terminal screws within the FACU, DACT, and other applicable devices in full compliance with manufacturers' requirements and system listings.

H. All wires shall be checked for grounds, shorts, opens, and correct resistance, capacitance and other applicable parameters prior to termination of the circuits at the fire alarm control unit or subpanels and prior to the installation of devices. The minimum resistance to ground or between any two conductors shall be 10 megohms, verified with a voltage generating insulation tester. The Contractor shall provide written documentation and certification of this testing on a per circuit basis. The Contractor shall give a minimum of 2 weeks' notice to the Engineer in advance of all testing so that these tests may be witnessed at the discretion of the Engineer.

I. Where wiring and conduit penetrate fire-rated barriers, appropriate fire stopping shall be put in place. Installation of materials shall result in fire resistance rating equal to or greater than the rating of the penetrated assembly, unless otherwise indicated.

J. Wherever wiring and cabling pass through building walls, floors and roofs or is exterior to the building, it shall be enclosed in EMT or flexible conduit. Penetrations through exterior walls or roofs shall be sealed weather tight.

K. Four-inch square or double-gang electrical boxes which house addressable devices shall not be used as a junction box for other circuits.

L. All junction boxes shall be painted red externally. Junction box covers shall also be painted red on both sides. The Contractor shall protect building structural elements and interior finishes from being painted. All junction boxes for which the circuit use is not readily discernible shall be permanently labeled. All junction boxes which contain devices shall be labeled. All labels shall consist of engraved phenolic signs which have been approved by the Engineer prior to installation. The use of handwriting to perform this identification is not acceptable.

M. To prevent insulation damage or device damage, the following requirements apply:
   1. Any threaded EMT or flexible conduit terminating at metal boxes or cabinets shall be provided with insulating bushings at throat of connector.
   2. Any EMT connectors must be the all steel compressing type with insulated throats. The exception to this is indenture type which may be used on exposed unfinished areas to obtain a tighter fit to the surface.

3. Provide a clamp or other approved restraining device where cables or wires which are not in conduit enter junction boxes.

N. All panel enclosures installed in gypsum wallboard walls shall be recess mounted interconnecting circuits and shall be concealed within the wall cavity or in the space above the suspended ceiling or other space to the maximum extent possible. All circuits shall be routed and secured in full compliance with NFPA 70.

O. All panel enclosures installed outside or in the fire pump room shall be arranged so that all penetrations into the enclosure shall be through the bottom of the enclosure. Coordinate location with construction drawings.

3.3 FIELD QUALITY CONTROL AND TESTING

A. The Contractor shall provide a qualified project superintendent for the overall management and supervision of the work.

B. The project superintendent shall assure that adequate supervision is provided during all periods of installation of the fire alarm system. The project superintendent and all job site supervisors shall have a minimum of five years of continuous experience in the installation of fire alarm systems of similar scope and complexity.

C. All system smoke detectors and heat detectors shall be suitably protected against contamination up to the time of the final acceptance tests.

D. Upon completion of the installation, the Contractor shall fully functionally test all alarm initiating devices, supervisory devices, control devices and notification devices for proper response and effectiveness. A trouble condition shall be initiated at each system device to verify circuit supervision. Operation of all annunciating devices including the fire alarm panels shall be verified. Testing shall include thorough sound level measurements of audible notification devices with these tests being fully documented by means of marked-up drawings.

E. The system shall be subject to inspection and acceptance by the Authorities Having Jurisdiction and for the purpose of determining that the system is in accordance with federal, state, local, and specification requirements and applicable standards of the NFPA and other related codes.

F. Prior to the system acceptance testing, the Contractor shall provide, in writing, certification that the installed system is in full compliance with the design documents and all applicable codes and standards. See Appendix “B” for a sample letter.

G. The Contractor shall be responsible for performing, documenting, and certifying requisite inspection and tests in accordance with applicable codes and standards for all equipment furnished under this specification. After completing his testing, the Contractor shall demonstrate full operational capability of the fire alarm system, as well as full compliance with all design documents, codes and standards, to the Engineer. The Engineer and Authorities Having Jurisdiction shall be notified two weeks in advance of this testing.

H. The Contractor shall perform supplemental tests and shall render additional services in connection with the fire alarm system, as directed, at no additional cost to the Owner. The effect of additional tests, if any, on the delivery schedule shall be determined prior to undertaking the test.

I. In the event the acceptance test of the system results in the need for system repair or modification, the Contractor shall demonstrate the operability of the system to the full satisfaction of the Owner and Engineer following the completion of repairs or modification and an additional 15-day burn-in period.

J. In the event that the Authorities Having Jurisdiction require a separate demonstration of the operability of the system for acceptance purposes, these additional tests shall be carried out by the Contractor without expense to the Owner.

K. The Contractor shall conduct an independent quality assurance review of all developed AutoCAD Version (2016 or newer) "record" drawings to assure accuracy and completeness of these drawings. These drawings, as well as the O&M manuals and all other system documentation, shall be turned over to the Owner/ Tenant prior to the start of the final acceptance tests.

3.4 TRAINING OF EMPLOYEES

A. An employee of the Contractor, the fire alarm equipment distributor, and/or a manufacturer's representative shall provide instruction to key employees of the Owner/ Tenant on the operation and maintenance of the complete system. The Contractor shall contemplate a minimum of four (4) separate training sessions of one to two hours in length. Some of these training sessions may need to be conducted after normal working hours in order to accommodate all working shifts. At least one of these training sessions shall be completed prior to the start of the first system 15-day burn-in period.

B. The training shall be arranged in two segments. The first segment shall include a detailed overview of the system operation for the benefit of the security staff. The second segment shall include a detailed review of system operation, control, troubleshooting, and periodic testing and maintenance. This training shall also include detailed instruction covering completion of programming changes for the system.

C. Six (6) bound copies which summarize the training instruction shall be submitted to the Owner/ Tenant for future reference.

D. A typical training session shall be videoed by the Contractor and three (3) copies of the video in DVD format turned over to the Owner/ Tenant for future training of employees.

~END OF SECTION~

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Appendix “A”

Submittal Checklist

SUBMITTAL CHECKLIST

P = PROVIDED
N/P = NOT PROVIDED
N/A = NOT APPLICABLE

ITEM	STATUS	INITIALS
A. Drawings		
1. Symbol Legend		
2. Initiating Device Locations Shown/Correct Symbols Used		
3. Initiating Device Addresses Shown		
4. Notification Device Locations Shown/Correct Symbols Used		
5. Notification Device Numbers Shown		
6. Circuit Point-to-Point Wiring to All Devices		
7. Complete Elementary Wiring Schematics		
8. Location of All Conduit Shown With Sizes Indicated		
9. Table Showing:		
a. Wire Counts		
b. Type		
10. Table of Conduit Fill Calculation Results		
11. Location of All Junction Boxes and Pull Boxes		
12. Table Indicating Color-Coding of Wires		
13. All Relays, Modules, Auxiliary Devices Shown/Correct Symbols Used		
14. All Drawings Same Size		
15. All Drawings Sequentially Numbered		
B. Complete Battery Calculations For Each Panel		

ITEM	STATUS	INITIALS
C. Current Manufacturer's Data Sheet Identifying Component By Part Number, Type, Etc.		
1. Boards		
2. Modules		
3. Amplifiers		
4. Power Supplies		
5. Batteries		
6. Transponder Control Modules		
7. Annunciator Control Modules		
8. Remote Display Annunciator		
9. Duct Detector, Detector Housing, Tubes		
10. All Enclosures		
11. All Other System Devices or Components		
12. Print-out of Program		
13. Installation Manual for FACU		
14. Installation Manual for Power Supply		
15. FACU Programming Instructions With Password Protection Levels		
16. Bill of Materials		
17. Manufacturers' Warranties		
18. Installers' Warranties		
19. Contractor Q.A. Certification		
20. Installation Instructions Which Are Included With Packaged Devices		
D. Wire Samples		

Appendix “B”

Letter of Certification

LETTER OF CERTIFICATION

Building 1
The Industrial Park

To Whom It May Concern:

I certify that XYZ Company has installed, inspected, and tested the fire alarm system in full compliance with all design documents and all applicable codes and standards.

Sincerely,

Max Worker
Manager, Testing and Inspections

Appendix “C”

Tables

Tables

Table 1. Percent of Cross Section of Conduit and Tubing for Conductors

Number of Conductors	1	2	Over 2
All Conductor Types	53	31	40

Table 2. Dimensions and Percent Area of Conduit and Tubing (Areas of Conduit or Tubing for the Combinations of Wires Permitted in Table 1)

Electrical Metallic Tubing					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.622	0.304	0.094	0.122	0.161
3/4	0.824	0.533	0.165	0.213	0.283
1	1.049	0.864	0.268	0.346	0.458
1-1/4	1.380	1.496	0.464	0.598	0.793
1-1/2	1.610	2.036	0.631	0.814	1.079
2	2.067	3.356	1.040	1.342	1.778

Flexible Metal Conduit					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.635	0.317	0.098	0.127	0.168
3/4	0.824	0.533	0.165	0.213	0.282
1	1.020	0.817	0.253	0.327	0.433
1-1/4	1.275	1.277	0.396	0.511	0.677
1-1/2	1.538	1.857	0.576	0.743	0.984
2	2.040	3.269	1.013	1.307	1.732

Rigid Metal Conduit					
Trade Size In.	**Internal Diameter In.**	**Total Area 100% Sq. in.**	**2 Wires 31% Sq. In.**	**Over 2 Wires 40% Sq. In.**	**1 Wire 53% Sq. In.**
1/2	0.632	0.314	0.097	0.125	0.166
3/4	0.836	0.549	0.170	0.220	0.291
1	1.063	0.888	0.275	0.355	0.470
1-1/4	1.394	1.526	0.473	0.610	0.809
1-1/2	1.624	2.071	0.642	0.829	1.098
2	2.083	3.408	1.056	1.363	1.806

SECTION 31 3116
TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chemical soil treatment.

1.02 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

C. Manufacturer's Application Instructions: Indicate caution requirements .

D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:
   1. Having minimum of three (3) years documented experience.
   2. Licensed in the State in which the Project is located.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for requirements for application and authority to use toxicant chemicals, and comply with EPA regulations.

1.06 SEQUENCING

A. Do not apply soil treatment solution until excavation, filling and grading operations are completed, except as otherwise required in construction operations.

B. Apply toxicant immediately prior to installation of vapor barrier under slabs-on-grade.

1.07 WARRANTY

A. Provide five year installer's warranty against damage to building caused by termites.
   1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
   2. Warranty shall state dates of application and chemicals used, including quantities and concentrations.
   3. Warranty shall be renewable on a year-to-year basis at end of five year period at Owner's option, for a fee to be agreed upon at time of renewal by Owner.
   4. Re-treatment upon evidence of subterranean insect activity shall be made at no charge to the Owner.

PART 2 PRODUCTS

2.01 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. Use an industry recognized, federal, state and locally approved, emulsible concentrate insecticide for dilution with water, uniform composition, and specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent.

C. Toxicant Chemical: EPA approved; synthetically color dyed to permit visual identification of treated soil.

D. Diluent: Recommended by toxicant manufacturer.

E. Mixtures of chemicals are prohibited, except as premixed from manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Schedule:
   1. Make application during normal working hours.
   2. Allow not less than 12 hours for drying after application, before covering treated area.

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. Coordinate soil treatment at foundation perimeter with finish grading and landscaping work to avoid disturbance of treated soil. Retreat disturbed treated soil.

3.03 PROJECT RECORD DOCUMENTS

A. Accurately record moisture content of soil before treatment, date and rate of application, areas of application, diary of meter readings and corresponding soil coverage.

B. A Certificate of Compliance shall be issued to the building department by the licensed applicator.

3.04 PROTECTION

A. Do not permit soil grading over treated work.

B. Post signs in areas of application, warning that soil treatment has been applied. Remove signs before treated areas are covered by other construction.

END OF SECTION

SECTION 32 1713
PARKING WHEELSTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete parking wheelstops and anchorage.

1.02 REFERENCE STANDARDS

A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

B. ASTM C150/C150M - Standard Specification for Portland Cement.

C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.

D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Parking Wheelstops: Precast concrete, conforming to the following:
   1. Nominal Size:
      a. Automobile: 7 inches high, 9 inches wide at base and 6 feet long, with chamfer corners.
      b. Truck: 10 inches high, 15 inches wide at base and 8 feet long, with chamfer corners.
   2. Profile: Manufacturer's standard, unless shown on drawings.
   3. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
   4. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
   5. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
   6. Air Entrainment Admixture: ASTM C260/C260M.
   7. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
   8. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
   9. Embed reinforcing steel, and drill or sleeve for two dowels.
   10. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
   11. Minor patching in plant is acceptable, providing appearance of units is not impaired.

B. Dowels for anchoring to pavement: Cut reinforcing steel, 3/4 inch diameter minimum, extending 18 inches minimum into natural grade.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Install units in alignment with adjacent work.

C. Fasten units in place with 3 dowels per unit. Fil holes with 1/2 inch sealant over foam backing.

END OF SECTION

SECTION 32 3113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Smoker's Canopy Enclosure.

B. Fence framework, fabric, and accessories.

C. Excavation for post bases; concrete foundation for posts and center drop for gates.

D. Manual gates and related hardware.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

B. Section 10 2213.10 - Interior Chain Link Partitions.

C. Civil Engieering Design Documents: Site fencing.

1.03 REFERENCE STANDARDS

A. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.

D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.

E. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.

F. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric).

G. CLFMI CLF 2445 - Product Manual - Drawings.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Line Posts: 1.9 inch diameter.

B. Corner and Terminal Posts: 2.38 inch diameter.

2.02 MATERIALS

A. Posts, Rails, and Frames: ASTM F 1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 25 ksi.

B. Line Posts: Type I round in accordance with FS RR-F-191/1D

C. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.

D. Wire Fabric: ASTM A392 zinc coated steel chain link fabric.

E. Barbed Wire: Zinc-coated steel, complying with ASTM A 121 Type Z Coating Class 1; 3 strands of 0.086 inch diameter wire, with 4-pointed barbs at 5 inches on center.

F. Concrete: Type specified in Section 03 3000.

2.03 COMPONENTS

A. Line Posts: 2.38 inch diameter.

B. Corner and Terminal Posts: 2.88 inch.

C. Swing Gate Posts for gate leaf widths:
   1. Up to and including 6 feet: 2.88 inch.
   2. Over 6 to 12 feet: 4.5 inch.
   3. Over 12 to 18 feet: 6.63 inch.
   4. Over 18 to 24 feet: 8.63 inch.

D. Swing Gate Frame for gate leaf widths:
   1. Up to 8 feet: 1.9 inch.
   2. Over 8 feet: 2.38 inch.

E. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.

F. Fabric: 2 inch diamond mesh interwoven wire, 9 gage, 0.1144 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.

G. Tension Wire: 6 gage, 0.1620 inch thick steel, single strand.

H. Tension Band: 3/4" wide x .074 inch (14 gage) thick steel.

I. Tie Wire: Aluminum alloy steel wire.

2.04 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.

D. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

E. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.05 FINISHES

A. Components, Accessories and Fabric: Galvanized in accordance with ASTM A 123/A 123M, at minimum 1.8 oz/sq ft.

B. Components, and Accessories: Polymer coating according to ASTM F 1043, 10-mil minimum PVC or 3-mil minimum polyester finish applied over coating of minimum 1.8 oz/sq ft galvanizing.

C. Polymer coating color shall be black.

D. Accessories: Same finish as fabric.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Place fabric on outside of posts and rails.

C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
   1. If not indicated on drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross-section of the post.

D. Line Post Footing Depth Below Finish Grade: ASTM F567.

E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

G. Do not stretch fabric until concrete foundation has cured 28 days.

H. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

I. Position bottom of fabric maximum 2 inches above finished grade.

J. Fasten fabric to line posts, braces, and tension wire with tie wire at maximum 15 inches on centers.

K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

L. Install tension wire stretched taut between terminal posts.

M. Install support arms sloped outward and attach barbed wire; tension and secure.

N. Do not attach the hinged side of gate to building wall; provide gate posts.

O. Install hardware and gate with fabric and barbed wire overhang to match fence.

P. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.02 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Components shall not infringe adjacent property lines.

END OF SECTION

MACGREGOR
ASSOCIATES
ARCHITECTS