SECTION 01 11 00
SUMMARY

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Scope of this Project is to construct alterations and additions to existing Fire Station located at 352 Nautilus Drive, Manahawkin, New Jersey. The work generally consists of, but is not limited to:

All labor, materials, and equipment necessary to construct an approximate 2,000 square foot masonry and steel framed West Garage Bay with a modified bituminous low slope roof system, the demolition of an approximate 600 square foot 1-story frame structure situated between two existing (North and South) garage bays and construction of new 2-story 900 square foot masonry and steel frame structure between the bays.

The Project includes the complete removal of roofs and ceilings throughout the existing North and South bays, and the construction of a new wood frame pitched roofing system over the North and South bays and the center section. The roof will be constructed of asphalt-fiberglass roof shingles over plywood sheathing over prefabricated and engineered wood roof trusses.

The existing foundations of the North and South garage bays will be reinforced with new concrete foundations and the masonry walls reinforced with new integral piers.

New HVAC units and condensing units will be installed on the low slope roof over the West Bay and electrical distribution will be reconfigured in the existing building areas. Electrical upgrades, new plumbing for toilet and shower rooms, modifications to the existing sanitary and underground drainage, and new mechanical systems throughout are also included.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 11 50
FIELD ENGINEERING

PART 1 – GENERAL

1.1 GRADES, LINE AND LEVELS

A. The Engineer will establish a number of benchmarks adjacent to the work. It will be the Contractor's responsibility when using a benchmark to check into a second benchmark to verify the elevation of the benchmarks throughout the length of the contract. The Contractor shall notify the Architect of any discrepancy.
B. Based on the information provided by the Architect, the Contractor shall verify all information, develop and make all detailed surveys necessary for construction, including slope stakes, batter boards, stakes for working points, lines and elevations.
C. Prior to the Contractor connecting to any existing pipe, the Contractor shall verify the elevation of the existing pipe by using established benchmarks. The Contractor shall notify the Architect of any discrepancy.
D. The Contractor will be required to furnish all necessary qualified personnel acceptable to the Architect, and adequate equipment to preserve such controls throughout the duration of the contract and to lay out all of the lines, grades, slopes, finish floor elevations, top of concrete, steel, and/or masonry elevations, etc. necessary for the complete construction of the Project. The Contractor shall make the necessary computations to establish the exact position of all the work from the control points which are shown on the plans or furnished by the Architect.
E. The Contractor shall make all measurements and verify all dimensions necessary for the proper construction of the work called for by the drawings and specifications. Any error or apparent discrepancy found in the drawings or specifications shall be called to the Architect's attention for interpretation prior to proceeding with the work.
F. The Contractor shall be responsible for the finished work to conform to the contract drawings, and he shall correct all errors caused by his personnel at his own expense.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 PAYMENT PROCEDURES

A. Schedule of Values: A Schedule of Values must be submitted within fourteen (14) days of Contract Award. Submit a Schedule of Values on Continuation Sheet, AIA Form G-703, itemizing in detail, labor and material values for each item of work. This Form will form the basis of the monthly Application for Payment to the Contractor.
   1. The Schedule of Values must be broken down to include each work task with separate line items for labor and material for each.
   2. The Schedule of Values shall include line items for Punch List, Operation and Maintenance Manuals, Final Training, and As-Built Drawings. If a Mobilization line item is included for the overall project and/or for subcontractors, a Demobilization line item of equal value shall also be included.

B. Monthly Payments: Prepare monthly payment requests on AIA Form G-702 with Continuation Sheet G-703. It is recommended that prior to the formal submission of the Application for Payment, that the Contractor meet with the Architect at the Project site to review progress and to determine the percentage of the work complete on a line item basis. Submit an original and two copies of each invoice.

C. Completed Payment Request must be received in the Architect's office no later than two-weeks prior to the monthly meeting of the Town Council. Refer to Staffordnj.gov for meeting schedule. Payment will be made within thirty (30) days of approval of the Contractor's invoice by the Township.

D. Certified Payrolls: Submit one (1) copy of the certified payrolls with each payment request.

E. Final Payment: Submit with final payment request the following documents:
   1. AIA Form G-702 with Continuation Sheet G-703
   2. Consent of Surety to Final Payment
   3. Affidavit of Payment of Debts and Claims
   4. Affidavit of Lien Release
   5. Final Certified Payroll
   6. Letter(s) of Warrantee
   7. Operation and Maintenance Manuals
   8. Systems Training
   9. Consent of Surety to Final Payment

1.2 FINAL INSPECTION

A. Prior to making the final payment and at a time mutually agreeable to the Township, A/E, and Contractor, the A/E will make a final inspection of the work and report to the Owner his findings. All deficiencies noted by the Architect at the time of this inspection shall be corrected by the Contractor before the Architect will authorize final payment.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.1 PRE-BID MEETING

A. A Pre-Bid meeting will be held on the date set forth in the Advertisement and Notice to Bidders. All Bidders should attend this meeting, as it will be the only time to visit the present Fire Station and site. All Bidder's questions must be received no later than fourteen (14) days after the Pre-Bid meeting. An addendum will be issued, no later than seven (7) days before bids are to be received, unless otherwise permitted by law.

1.2 PRECONSTRUCTION CONFERENCE

A. Before submission of a notice to proceed, the Engineer, the Township of Stafford Project Representative, the Contractor and the Contractor's Superintendent, shall attend a preconstruction conference. The purpose of this conference will be to establish the administrative procedures that will be followed during the construction period.
B. At the conference, the Contractor shall submit to the Architect/Engineer, a list of all materials and equipment suppliers for the Architect/Engineer's review. The Contractor shall also submit his construction progress schedule indicating starting and completion dates of the various phases of construction. Procedures for handling shop drawings and for processing monthly estimates for payment will be determined. The Contractor shall also submit the name and address of a responsible individual who will be available on a 24-hour basis to handle all emergency problems in connection with the Project.
C. Representatives of the local police, fire, first aid, and utility companies may be invited to attend the preconstruction conference.

1.3 PROGRESS MEETINGS

A. Construction Progress Meetings will be held at the Project site on a bi-weekly basis. Attendees shall include the Contractor, all prime subcontractors, and other applicable subcontractor(s).
B. The Contractor shall provide a Two-Week Look-Ahead Schedule at each meeting. The two-week look-ahead shall indicate the work to be performed on each workday, in detail, for the forthcoming two weeks. Refer to Section 01 32 16.
C. Meetings will be held at the time and place designated by the Architect/Engineer. All decisions, instructions and interpretations given by the Architect/Engineer at these meetings shall be binding and conclusive on the Contractor. The proceedings of these meetings will be recorded by the Architect/Engineer and each Contractor will be furnished with a PDF copy for his use and distribution to the various subcontractors, material, men, and vendors involved.
D. At the progress meeting the Contractor shall inform the Township of Stafford Project Representative in advance concerning his plans for carrying on each part of the work. If at any time the Contractor's plan, or equipment, or his methods of executing the work appear to the representative to be inadequate to insure the required safety, quality, or rate of progress of the work, the representative may order the Contractor to increase or improve his facilities or methods and the Contractor shall promptly comply with such orders, but neither compliance with such order nor failure of the Township of Stafford Project Representative to issue such orders shall relieve the Contractor from his obligation to secure the degree of safety, the quality of work, and the rate of progress required by the contract. The Contractor alone shall be responsible for the safety, adequacy, and efficiency of his plan, equipment, and methods. Review by the Township of Stafford Project Representative or Architect/Engineer of any plan or method of work proposed by the Contractor shall not relieve the Contractor of any responsibility therefore, and such review shall not be considered as an assumption of any risk or liability by the Owner, Architect/Engineer, or Resident Project Representative, or any officer, agent or employee thereof. The Contractor shall have no claim on account of the failure or inefficiency of any plan or method so reviewed.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 – GENERAL

1.1 NOTICE TO PROCEED

A. The Township of Stafford will submit to the Contractor a written "Notice to Proceed" stating a date on which it is expected that the Contractor will start the work. Contract time shall commence on the date specified in the "Notice to Proceed".

1.2 CONSTRUCTION TIME

A. The construction shall be completed within **three hundred (300) calendar days** from the issuance of the Notice To Proceed.

1.3 PROJECT SCHEDULE

A. The Contractor shall submit a CPM construction schedule within ten (10) calendar days of the Notice to Proceed for review and approval.
B. The Contractor shall submit to the Architect/Engineer such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Architect/Engineer may request concerning work performed or to be performed under this contract.
C. Provide at each bi-weekly Project Meeting, a written Project schedule analysis.
D. Provide at each bi-weekly Project Meeting, a written outline of the work completed within the past two (2) weeks and a forecast of work projected within the next two (2) week period.
E. If the Project should fall behind schedule, provide a complete revised Recovery Schedule when requested by the Architect.

1.4 PROGRESS REPORTS

A. The Contractor shall furnish progress reports satisfactory to the Architect/Engineer, which clearly indicate the number of men and major pieces of equipment, under his employ or his subcontractor's employ, what each trade has accomplished for the day, weather conditions, delays, accidents and all other pertinent information. Each report shall be signed by the Contractor's Superintendent.

1.3 LIQUIDATED DAMAGES

A. The Contractor and their Surety shall be responsible to pay the Township the sum of five hundred dollars ($500.00) per day for each calendar day the Project remains uncompleted beyond the completion dates.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 00
SPECIAL PROJECT PROCEDURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 WORK HOURS

A. Contractor on-site working hours are between 7:00AM and 4:00PM weekdays. No work is permitted on weekends or State Holidays, unless prior approval is obtained from the Township.

1.3 CLEAN-UP

A. The Contractor is responsible for all site clean-up and debris removal and disposal on a daily basis, including nails and fasteners. Utilize magnets to retrieve ALL nails, screws, and other metal debris.
B. At the end of each workday, and prior to exiting the Facility, the Contractor shall clean-up the grounds within and adjacent to the work areas, screening for, and removing construction debris. The Superintendent shall verify that the cleanup is complete.

1.4 SITE PROTECTION

A. Protect adjacent finishes from damage. Repair any damages created by the work.
B. Protect concrete and paved surfaces from damage that may be caused by roll-off dumpsters.

1.5 SITE RESTORATION

A. Without expense to the Owner, restore to its original condition any property, including all walkways, driveways, lawns, or plantings, scheduled to remain, that have been damaged due to the negligence and/or work of the Contractor's agents, employees, or Subcontractors. Complete all such repairs to the satisfaction of the Architect and the Township of Stafford.

1.6 STAGING AND STORAGE

A. Full dumpsters are not permitted to remain within the site overnight and shall be removed from the Facility at the end of the workday.
B. The Contractor's Superintendent shall be onsite to accept any deliveries and whenever work of any kind, including subcontractor work, is occurring. The Township will not accept deliveries on the Contractor's behalf.

1.7 UNDERGROUND UTILITY SURVEY AND PROTECTION PLAN

A. The Contractor shall provide an underground utility detection survey and underground utility protection plan for all areas where construction is to occur, and/or heavy equipment will be utilized on-site in unpaved areas that are not covered by the areas specifically shown on the drawings. The intent of this requirement is to prevent damage to underground utilities during the construction. The Contractor shall engage and pay for an underground utility locator service to conduct the underground utility survey utilizing both electromagnetic and ground penetrating radar detection methods. The survey and plan shall be submitted for review and approval prior to commencement of on-site construction activity.

1.8 BUILDING ACCESS

A. The Contractor shall protect all interior areas of the building that are scheduled to remain.
B. The Contractor shall take special precautions to protect the interior finishes. Any finishes scheduled to remain that are damaged during the work shall be restored by the Contractor at no additional cost to the Township.

1.9 SITE AND BUILDING ACCESS AND RESTRICTIONS

A. Maintain 48" wide clear and unobstructed path for Fire Department access to Siamese Fire Department connections. Do not block with fences, dumpster, or stored materials.
B. All existing fire hydrants, hose connections, walkways, gates, entrances, and exits shall be kept clear and unobstructed throughout construction.
C. Blowers shall not be utilized on this Project and dropping of debris or materials from above ground level is prohibited.

1.10 TEMPORARY SANITARY FACILITIES

A. The Contractor must provide temporary toilets for their employees. Temporary toilets must be locked overnight and on weekends.

1.11 FIRE PROTECTION

A. The Contractor at all times must maintain good housekeeping practices to reduce the risk of fire damage. All scrap materials, rubbish, and trash must be removed daily from in and about the buildings and the Contractor must not permit them to be scattered on adjacent areas.
B. Suitable storage space must be provided outside the building areas for storing flammable materials; no storage will be permitted in the buildings. Any excess flammable liquids being used inside the buildings must be kept in closed metal containers and removed from the buildings during unused periods.
C. A fire extinguisher must be available at each location where cutting is being performed.
D. The Contractor must provide fire extinguishers in accordance with the recommendations of NFPA Bulletins Nos. 10 and 241. However, in all cases a minimum of one (1) fire extinguisher must be available on each job site.

1.12 HOT WORK

A. If hot work (welding, burning, or work involving open flame) is performed onsite as part of this Project, the Contractor is required to obtain and conform to the requirements of hot work permits:
    1. The Contractor must contact the New Jersey Division of Fire Safety (DFS) to obtain a hot work permit for the duration of this Project, as required by N.J.A.C. 5:70-2.7. Application must be completed via DCA RIMS website (http://www.nj.gov/dca/divisions/codes/RIMS_online.html) which requires account setup by the applicant. The Contractor must pay the DFS directly for this permit. A separate permit will be required for the work to be performed at each building. The Contractor shall submit a copy of the DFS Hot Work Permit to the Township of Stafford prior to commencing the covered work.

1.13 AIR QUALITY DURING RENOVATION WORK

A. Before selection and use of paints, adhesives, sealants, solvents, or installation of insulation, particle board, plywood, floor coverings, carpet, textiles, or other materials in the course of renovation or construction, the employer shall check product labels and Material Safety Data Sheets or seek and obtain information from the manufacturers of those products on whether or not they contain volatile organic compounds such as solvents, formaldehyde or isocyanates that could be emitted during regular use. Copies of MSDS for all applicable products shall be provided to the Township prior to application.

1.14 WEATHER PROTECTION

A. The building must be protected from weather damage throughout the work. The Contractor will be responsible to replace any finishes, building, or infrastructure that is damaged due to failure to adequately protect against weather damage during the work.

1.15 TEMPORARY FENCING

A. The work area shall be enclosed with secure temporary chain-link metal fencing. Fencing is required to be 8'-0" high with all sections attached together. The fences shall be of the type that is founded on pads and not with posts driven into the ground. All sections of the fence shall be securely clipped together. Gates for the fencing shall be padlocked and five (5) sets of keys for each lock shall be provided to the Township of Stafford.

1.16 CLEANING

A. Before the final acceptance by the Architect, the Contractor shall remove from the site all equipment, temporary work, unused and useless materials, rubbish and temporary construction, shall repair or replace in an acceptable manner fences or other private or public property which may have been damaged or destroyed on account of the prosecution of the work, shall fill all depressions and waterpockets on public and private property caused by his operations, shall clean all drains and ditches within and adjacent to the site which have been obstructed by his operations and shall leave the site and adjacent public and private property in a neat and presentable condition wherever his operations have disturbed conditions existing at the time of starting work.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.1 CODES, PERMITS, AND INSPECTIONS

A. Codes: The work described by these Contract Documents, shall be accomplished in strict accordance with and in full compliance with the following Codes and Standards:

- INTERNATIONAL BUILDING CODE, NEW JERSEY EDITION, 2021
- NFPA 70, NATIONAL ELECTRICAL CODE, 2020
- NFPA 72, NATIONAL FIRE ALARM CODE, 2021
- INTERNATIONAL FUEL GAS CODE, 2021
- INERNATIONAL FIRE CODE, 2021
- NATIONAL STANDARD PLUMBING CODE, 2021
- ANSI/TIA/EIA STANDARDS AS REFERENCED BY APPLICABLE CODES AND STANDARDS
- NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA) STANDARDS
- UNDERWRITERS LABORATORIES, INC. (UL) STANDARDS AS REFERENCED BY APPLICABLE CODES AND STANDARDS
- ASHRAE 90.1-2019, ENERGY STANDARDS FOR BUILDINGS EXCEPT LOW-RISE RESIDENTIAL
- ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
- NFPA 110, EMERGENCY AND STANDBY POWER SYSTEMS
- INTERNATIONAL MECHANICAL CODE, 2021
- ICC/ANSI A117.1-2017
- NFPA 13 INSTALLATION OF SPRINKLER SYSTEMS

B. Building Permits: The Contractor shall submit signed and sealed construction drawings provided by the Architect to the Stafford Township Construction Department for plan review and approval/release. The Contractor, and respective subcontractors, shall be responsible for completing, signing, and submitting permit applications as required by the New Jersey Uniform Construction Code.

C. Construction Inspections: All construction inspections will be provided by the Township of Stafford Construction Department

D. Utility Connection Charges: The Township of Stafford will pay all utility connection charges directly, except for the installation and usage fees for temporary services during construction.

1.2 SITE SAFETY

A. The Contractor is solely responsible for all site safety and compliance with OSHA regulations.

B. The Contractor shall inspect and assure compliance with all statutory requirements for worker protection and safety. The Contractor shall provide, inspect, and assure that all workers utilize appropriate worker protective and safety gear.

C. Instruct workers and inspectors in the proper use of all protective and safety equipment.

1.3 EQUIPMENT – MATERIALS

A. Manufactured products of the United States, whenever available, shall be used in this work. Wherever practicable, preference shall be given, at all times, to material and equipment manufactured, or produced, in the State of New Jersey, where such preference is reasonable and will best serve the interest of the Township.

1.4 DEFINITIONS

A. Trades: Refers to those specifically skilled in the work performed under a particular section of this contract.
B. General Contractor/G.C.: Shall mean that Contractor is responsible for the work of Divisions 2 through 14 and 31 through 33 inclusive.
C. Fire Protection Contractor or Sub-Contractor/F.C.: Shall mean the Contractor or sub-contractor is responsible for the Fire Protection work described work in Division 21 and indicated on the Fire Protection drawings. Some general construction work may pertain to this work.
D. Plumbing Contractor or Sub-Contractor/P.C:. Shall mean the Contractor or sub-contractor is responsible for the Plumbing work described in Divisions 21 and 22 and indicated on the plumbing drawings. Some general construction work may pertain to this work.
E. Mechanical Contractor or Sub-Contractor/M.C.: Shall mean the Contractor or sub-contractor is responsible for the work described in Division 23 and indicated on the mechanical drawings. Some general construction work may pertain to this work.
F. Electrical Contractor or Sub-Contractor/E.C.: Shall mean the Contractor or sub-contractor is responsible for the work described in Division 26, 27, and 28 and indicated on the electrical drawings. Some general construction work may pertain to this work.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 00
QUALITY ASSURANCE

PART 1 – GENERAL

1.1 QUALITY ASSURANCE

A. Clean construction and adjoining areas daily and remove, legally disposing of all materials.
B. Provide day-to-day site supervision through a Site or Project Superintendent who uses English as their primary language. Work will not be permitted to be performed without the approved Superintendent present, including any subcontractor work. The Superintendent shall be present at the site during all construction activities, including subcontractor work, shall attend all bi-weekly construction progress meetings, shall be present for all subcontractor activities, and shall be present to accept and review all deliveries.
C. Assure that site supervision, craftspersons, and subcontractors are knowledgeable and experienced in their portion of the work and know and understand the specified requirements and methods needed for performance of the work.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 23
TESTING AND INSPECTION SERVICES

PART 1 – GENERAL

1.1 TESTING AGENCIES

A. The Contractor shall engage, and pay for, a testing agency(s) acceptable to the Architect, to conduct all testing and inspection services listed below.

1.2 SPECIAL TESTING AND INSPECTIONS

A. Compaction Testing
B. Concrete Quality Control Inspection and Testing including reinforcement and formwork
C. HVAC Testing and Balancing

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 52 00
CONSTRUCTION FACILITIES AND TEMPORARY UTILITIES AND CONTROLS

PART 1 – GENERAL

1.1 TEMPORARY TOILET FACILITIES

A. The Contractor shall be responsible for providing temporary toilet facilities for his employees. The location of such facilities shall be at a location approved by the Owner. Secure and lock toilets at the end of each work day. Sanitary facilities shall conform with Board of Health, State and Local requirements.

1.2 CONTRACTOR FIELD OFFICE

A. The Contractor shall be responsible for providing a temporary field office, minimum 10’ x 50’ to be located at a location to be determined at the Notice to Proceed Meeting. The field office is for the Contractor’s field operations and for use by the Architect/Engineer (A/E) for meetings. The field office shall be heated and cooled. Provide a conference table and chairs for twelve (12) people as well as a separate office for the Contractor’s use and a layout table within the conference space. The Contractor shall be responsible for obtaining construction permitting for the field office and electrical connections.

1.3 TEMPORARY UTILITES

A. Temporary Power: The Contractor may utilize the building’s 120v electrical outlets for use during construction. If no power is available within the work areas due to the nature of the work, the Contractor shall provide temporary power by means of portable generators.
B. Temporary Water: Contractor may obtain temporary water from the existing building’s water supply. The provision of potable water for workers is the responsibility of the Contractor.
C. Temporary Lighting: The Contractor will be responsible to provide any temporary lighting necessary to perform the work.
D. Temporary Heat: The Contractor will be responsible to provide any temporary heat necessary to perform the work and to assure that there is no thermal or humidity damage to stored or installed materials or finishes.
E. Any temporary utilities provided by the Township may be revoked if deemed necessary by the Township. The Contractor will then be solely responsible for supplying the necessary temporary utilities to complete the work.
F. Contractor shall pay for the installation and use of all the utility services during the course of construction and shall pay all fees and charges thereof.

1.4 TEMPORARY SANITARY FACILITIES

A. Provision of toilet facilities for workers is the Contractor’s responsibility.

1.5 BARRIERS

A. Barricades and Guide Rails: The General Contractor shall adequately barricade all excavations, soft trenches, construction obstructions and other hazardous areas as required to meet all applicable codes and to provide safe conditions, and to the satisfaction of the Architect.

1.6 FIRE PROTECTION

A. The Contractor, at all times, must maintain good housekeeping practices to reduce the risk of fire damage. All scrap materials, rubbish, and trash must be removed daily from the site, and the Contractor must not permit them to be scattered on adjacent areas.

B. Suitable storage space must be provided outside the building area for storing flammable materials; no storage will be permitted in the building. Any excess flammable liquids being used inside the building must be kept in closed metal containers and removed from the building during unused periods.
C. A portable fire extinguisher must be available at each location where cutting is being performed.
D. The Contractor must provide fire extinguishers in accordance with the recommendations of NFPA Bulletins Nos. 10 and 241. However, in all cases, a minimum of one (1) fire extinguisher must be available on the job site.
E. Smoking is prohibited within the Facility except for the designated smoking areas.
F. Refer to Section 01 35 00 for additional requirements.
G. If compressed gas bottles are utilized, they must be properly secured.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 61 00
SUBMITTAL PROCEDURES AND PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 SHOP DRAWINGS AND SUBMITTAL PROCEDURES

A. The Architect/Engineer (A/E) will prepare, and submit, a Submittal Log identifying all required submittals and will distribute the log at the pre-construction meeting. The Contractor may provide additional submittals in addition to those listed on the Log.

B. Contractor's Transmittal Form: This form is to be used for submission for approval of all materials to be utilized in the piling installation, manufacturers/suppliers, and for Professional Services. The form shall include:

1. ***Contractor Name:*** The Prime Contractor submitting the form inserts his company name in the space indicated.
2. ***Description of Submittal:*** The Prime Contractor is to give a brief description of the submittal.
3. ***General Condition, Specification or Drawing Section***: The Prime Contractor is to identify the Article, Spec Section, or Drawing that represents the submission type, i.e., Article 4.11.2 Sleeve & Opening Drawing, Spec Section 11 55 75 Condensate Pump, Drawing FP2.2 Ames Backflow Preventor.
4. ***Vendor/Manufacturer/Supplier/Subcontractor:*** The Prime Contractor is to include the name, address, and telephone number of the vendor/manufacturer/supplier or subcontractor for which he is requesting approval.
5. Include Contractor's Certification of compliance with the Contract Documents.

C. All submittals shall be identified by the tracking number on the submittal log.

D. All submittals shall be made electronically. Submittal shall include Contractor's transmittal and additional pages containing the submittal data, or drawings, in a single .PDF file. At minimum, the file name shall contain the tracking number and the submittal name, i.e. "0301 Concrete Design Mix.pdf". Submittals shall be emailed to the A/E. The Subject line of the e-mails shall contain the Project title, submittal tracking number, and submittal description.

E. A/E approved, or rejected, submittals will be emailed to the Contractor.

F. Shop Drawings: Shop drawings and samples shall be dated and marked to show the name of the Project, Architect, Contractor, originating subcontractor, manufacturer or supplier and detailer, if pertinent. Shop drawings shall completely identify Specification section and locations at which materials or equipment are to be installed. Reproduction of the Contract drawings is acceptable as shop drawings only when specifically authorized in writing by the Architect. Submission of shop drawings, manufacturer's specifications, installation instructions, material diagrams, and samples shall be accompanied by the Contractor's transmittal form. **Where printed material describes more than one product or model, clearly identify which is proposed to be furnished**. The Contractor is responsible for obtaining and distributing required prints of shop drawings to subcontractors, and material suppliers after, as well as before, final approval. Prints of reviewed shop drawings shall be made which carries the Architect's appropriate stamp.

G. Product Data:
1. Submit only pages which are pertinent; mark each copy of standard printed data to specifically identify only pertinent products; identify each submittal by designated submittal reference number. Show standards, performance characteristics, and capacities; wiring and piping diagrams; controls; component parts; finishes; dimensions; and require clearances.
2. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to work of this project. Delete information not applicable.

H. All submittals shall be made within thirty (30) calendar days of the Notice to Proceed.

I. Enforcement of Submittal Requirement:

1. The Contractor will be required to provide shop drawings, testing, laboratory test reports, product samples, and test installations in order to establish acceptable standards of workmanship.
2. **The requirement for submittal and review of <u>all</u> specified shop drawings, test, product samples, and test installations will be <u>rigorously enforced.</u>** General work of each section shall not commence prior to required review. All work conducted prior to the review of required submittals, including test installation, is subject to rejection by the Architect. All rejected work shall be removed and replaced by the Contractor at no additional expense to the Owner.

J. Contractor's Examination of Submittals: Prior to forwarding submittals to the Architect, the Contractor shall:
   1. Review submittals to verify quantities, field measurements, field construction criteria, assembly and installation requirements, manufacturer's catalog numbers, and conformance of submittals with requirements of Contract Documents.
   2. Review each submittal to determine that it is acceptable in terms of the means, methods, techniques, sequences and operations of construction, and in terms of safety precautions, all of which are the Contractor's sole responsibility.
   3. Clearly call to the Architect's attention any submittal that varies from what the Contract Documents have called for. Notify the Architect in writing at time of submittal of any deviations from requirements of Contract Documents.
   4. Clearly identify the products, or product data, which are pertinent to this Project. Clearly mark through, or delete, all information which is not applicable.
   5. Stamp and sign each submittal to certify that the Contractor has checked for completeness and compliance with requirements of the Contract Documents and that the submittal has his/her approval.
      a. The stamp shall state: "I certify that I have reviewed the above submittal and have verified that products, field dimensions, quantities, and field construction criteria comply with and have been coordinated with the requirements of Work and Contract Documents".
      b. Samples or submittals which, in the opinion of the Architect, have clearly not been checked for compliance by the Contractor will not be reviewed and it will be the responsibility of the Contractor to arrange for return of such submittals.

   6. Do not fabricate products or begin work which requires submittal review until return of submittal with Architect's acceptance. Work begun or completed prior to the Architect's review of required submittals is subject to rejection. Remove and replace rejected work at no additional cost to the Owner.

K. Architect's Review:
   1. Allow fourteen (14) days for Architect's review of each submittal. Daily allowance is time in possession of Architect and exclusive of delivery from and to Contractor and exclusive of resubmissions.
   2. The Architect's review is limited to aesthetics, general conformance with the Project design intent, and general compliance with information contained in Contract Documents. The Architect's review is neither a verification of Contractor's examination nor a substitution of Contractor's responsibilities. Architect may inform Contractor of any conspicuous errors on a submittal without prejudice to being held harmless to Contractor's examinations and responsibilities. Dimensional conformity and verification of existing dimensions, is the Contractor's responsibility.
   3. Upon review, any action shown by the Architect is subject to the requirements of the plans and specifications. The Architect's review <u>does not</u> authorize changes in Contract requirements unless a separate written directive or change order is issued. The Contractor is responsible for conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating his or her work with that of all other trades, and performing all work in a safe and satisfactory manner.
   4. **The Architect will not review:**

a. Any submittal which is not called for by the Contract Documents or not requested in writing by the Architect.
b. Any submittal which does not bear the Contractor's stamp and signature certifying that he has checked the submittal for completeness and compliance with the Contract Documents and that the submittal has his/her approval.
c. Any submittal which does not bear the Project name and Contract number and the Contractor's, subcontractor's, and supplier's names, addresses, and phone numbers.
d. Any submittal which does not clearly identify pertinent product (if more than one is shown). Clearly mark through all information which is not applicable.

5. The Architect will not accept and will not review "faxed" submittals or submittals copied from a telefaxed transmission unless previously authorized by the Architect in the interest of the Project.

L. The Contractor shall be required to make submittals, revise and resubmit as required, and establish compliance with the specified requirements requested in all sections of these Technical Specifications that are a part of this Contract Document. These submittals include but are not limited to shop drawings, manufacturer's literature, samples, colors, mock-ups, inspection reports, certifications, and delivery receipts.
M. It is also the Contractor's responsibility, when so required by the Contract Documents or by written request from the Owner, to deliver all required proof that the materials or workmanship, or both, meet or exceed the requirements of the specifically named Code or industry standard.
N. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of the submittal and the Architect has given approval of the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in the Shop Drawings or similar submittals by the Architect's approval thereof.

1.2 SAMPLES

A. All materials furnished by the Contractor to be incorporated in the work shall be subject to the review and inspection of the Architect/Engineer. No material shall be processed or fabricated for, or delivered to, the work without prior review of the Architect/Engineer, except at the risk of the Contractor.
B. The Contractor shall submit to the Architect/Engineer notarized certification of compliance from all material suppliers.
C. When required by either the Drawings or the Specifications, the Contractor shall submit samples of materials to demonstrate that the materials conform to the Specifications. Such samples shall be furnished, taken, stored, packed, and shipped as directed, at the expense of the Contractor.

1.3 SUBSTITUTIONS

A. Contractor's proposed substitutions shall be made within seven (7) calendar days from the Notice to Proceed. After that time has expired no substitutions will be considered. Substitution submittals that are incomplete will be rejected.
B. Every substitution shall be accompanied with a certification from the Contractor that they have personally investigated the proposed substitution and that it meets, or exceeds, the specified item.
C. Every substitution must be accompanied with a credit change order.
D. Implied substitutions are not acceptable.

PART 2 – MATERIALS (NOT USED)
PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 66 00
PRODUCT TRANSPORTATION, HANDLING, AND STORAGE

PART 1 – GENERAL

1.1 TRANSPORTATION AND HANDLING

A. The Contractor shall see to it that all equipment and material is delivered to the Project site in good condition.
B. The Contractor shall coordinate with his suppliers to ensure timely deliveries so as not to delay construction.
C. The Contractor shall take whatever measures are necessary to provide for adequate handling of the equipment and materials.

1.2 STORAGE AND PROTECTION

A. The Contractor shall be solely responsible for obtaining all work areas, storage sites, access to the site or temporary rights-of-way which may be required for proper completion of the work. The Contractor shall obtain prior approval of all work areas, storage sites, access to the site or temporary rights-of-way. Proof of approval shall be submitted to the Architect prior to their use on roads in residential or commercial areas.
B. It shall be understood that the responsibility for protection and safekeeping of materials and equipment on or near the site will be entirely that of the Contractor and that no claim shall be made against the Township by reason of any act of any employee or trespasser.
C. The Township will not accept any deliveries on behalf of the Contractor.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE MANUALS

PART 1 – GENERAL

1.1 MAINTENANCE MANUALS

A. General Requirements: Submit two (2) bound sets of the Operation and Maintenance Manuals as hereinafter defined for review by Architect and Engineers. Upon approval, correct any deficiencies and return two (2) bound sets to the Owner. Create a DVD or USB drive copy of the Operation and Maintenance Manuals including a copy of the as-built drawings. Submit one copy to the Owner with the Operation and Maintenance Manuals and one copy for the Architect's file.

B. General Contractor: This Maintenance Manual shall be divided into six (6) sections, as follows:
   1. Subcontractor, material supplier listings. The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warrantees and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of approved submittal cuts, together with parts lists and operating instructions shall be in this Section.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Code inspection reports
   6. Testing agency inspection reports

C. Fire Protection Subcontractor: This Maintenance Manual shall be divided into a section for each submittal item, be indexed and tabbed, and each equipment section shall be divided into six (6) sub-sections, as follows:
   1. Subcontractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warrantees and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts list for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of valve tag chart
   6. Copy of Installation and Operating Instructions for all equipment. Provide copies of the Contractor's Material and Equipment Certificate: Certify that system has been tested and meets or exceeds Code requirements. Provide three (3) copies of this Certificate to the Architect and provide one (1) copy in each O & M Manual. Post one (1) copy near Sprinkler Riser in Frame.

   Upon completion of entire system covered by these Specifications, a Certificate of Approval from the Code agencies having jurisdiction, shall be obtained and then delivered to the Architect.

D. Plumbing Subcontractor: This Maintenance Manual shall be divided into a section for each submittal item and be indexed and tabbed and each equipment section shall be divided into six (6) sub-sections, as follows:
   1. Sub-contractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warrantees and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts list for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of valve tag chart
   6. Copy of Installation and Operating Instructions for all equipment

E. H.V.A.C Subcontractor: This Maintenance Manual shall consist of an index listing all items for which a submittal was required, and each of these tabbed sections will include five (5) sub-sections, as follows:
   1. Subcontractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warrantees and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts list for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of Equipment Installation and Operating Manual for each piece of equipment and System.

F. Electrical Subcontractor: This Maintenance Manual shall consist of an index listing of all items for which a submittal was required and each of these tabbed sections will include five (5) sub-sections, as follows:
   1. Subcontractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warranties and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts lists for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of Equipment Installation and Operating Manual for each piece of equipment and System.

G. Communications Subcontractor (Division 27): This Maintenance Manual shall consist of an index listing of all items for which a submittal was required and each of these tabbed sections will include five (5) sub-sections, as follows:
   1. Subcontractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warranties and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts list for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of Equipment Installation and Operating Manual for each piece of equipment.

H. Electronic Safety and Security Subcontractor (Division 28): This Maintenance Manual shall consist of an index listing of all items for which a submittal was required and each of these tabbed sections will include five (5) sub-sections, as follows:
   1. Subcontractor, material supplier listings: The names, addresses and telephone numbers shall be listed and indexed for each component or item incorporated into the work.
   2. Warranties and Guarantees: All required warranties and guarantees shall be placed in this Section.
   3. Copies of component parts list for each item, and list of recommended spare parts.
   4. Shop Drawings: Copies of approved shop drawings delineating all as-built conditions shall be set forth in this Section.
   5. Copy of Equipment Installation and Operating Manual for each piece of equipment.

1.2 AS-BUILT DRAWINGS

A. The Contractor is required to maintain an updated set of “as-built” drawings on-site throughout the course of the Project. The Contractor shall present the as-built drawings for review at each Progress Meeting.
B. Complete construction As-Builts, certified by the Contractor, as complete to the best of his knowledge, must be provided at the completion of the Project.

PART 1 – MATERIALS (NOT USED)

PART 2 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 33
INSURANCE

PART 1 – GENERAL

1.1 CERTIFICATES OF INSURANCE

A. The Contractor shall not commence work under this contract until he has provided insurance of such character and in such amounts as specified in General Conditions / Supplementary Conditions in order to provide adequate protection for the Owner, the Architect, Engineer, and the Contractor against all liabilities, damages, and accidents.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 36
WARRANTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 WARRANTIES

A. The Contractor shall provide one (1) full set of the Original, signed, dated, and fully executed warranties to the Township of Stafford at Project Completion.
B. The Contractor shall include copies of the fully executed warranties in each of the Maintenance Manuals, as required by Section 01 78 23.
C. Provide all warranties required under the individual specification sections.

PART 2 – MATERIALS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02 50 00
PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

The Contractor shall furnish all labor, materials and equipment necessary to restore or replace as directed, all paved surfaces removed or damaged, or indicated to be milled and repaved.

1.2 RELATED WORK

Although it is not to be considered comprehensive, attention is brought to the following specifications listed elsewhere which are particularly pertinent:

- Supplemental Conditions
- General Conditions

1.3 REFERENCES

New Jersey State Highway Department Standard Specification for Road and Bridge Construction (Latest Revision).

AASHTO T 90-70	Standard Methods of Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99-70	Standard Methods of Test for the Moisture-Density Relations of Soils Using a 5.5-lb. Rammer and 12-Inch Drop

1.4 SUBMITTALS

Job mix design and gradation.

PART 2 - MATERIALS

2.1 GRAVEL BASE COURSE

Gravel base course shall be DGA soil aggregate for local and County roadway.

2.2 TACK COAT

Tack coat shall be applied in accordance with the latest requirements of the State Highway Department and shall be cutback asphalt, grade MC-70, or emulsified asphalt grade RS-1, conforming to the requirements therefore specified in the appropriate sections inclusive, and of the State Highway Department Standard Specifications, latest revision.

2.3 STABILIZED BASE COURSE

Bituminous stabilized base pavement materials shall be HMA 19.5 M64 for County roadways conforming to the latest revisions of the State of New Jersey, Department of Transportation.

2.4 TOP COURSE

Bituminous top course pavement materials shall be HMA 9.5 M64 for County roads conforming to the latest revisions of the State of New Jersey, Department of Transportation.

PART 3 - EXECUTION

3.1 INSTALLATION

The type and thickness of paving shall be as specified on the detail drawings.

During the Contractor's construction operations, all pavement, drives and sidewalk areas shall be maintained in a safe and satisfactory condition. The Contractor shall keep the pavement clean and shall sweep, hose down and otherwise maintain the streets in a safe and satisfactory condition for traffic including temporary traffic lines where previously removed.

It is the obligation of the Contractor to keep all working areas free from dust during construction. Pavement areas shall be swept clean at the end of each day's work. The Contractor shall use a pick up type sweeper for cleaning pavement.

Dust control shall, in all respects, be the obligation of the Contractor.

During the interval between the completion of the base course paving and top course paving, all pavement, drives and sidewalk areas shall be maintained in a safe and satisfactory condition. The Contractor shall keep the pavement clean and shall sweep, hose down, and otherwise maintain the streets in a safe and satisfactory condition for traffic including temporary traffic lines.

3.1.1 GRAVEL BASE COURSE

A compactive effort must be utilized to achieve a minimum of 95% standard proctor density to a depth of twenty-four (24) inches in the sub-base material. The sub-base material shall not be wet or frozen when the gravel base course is about to be placed thereon. The gravel shall be spread in the quantity and shaped so that when compacted and finished it will be of the thickness and at the finished grade as shown on the plans. Frozen material shall not be used. A compactive effort must be utilized to achieve a minimum of 95% standard proctor density in the gravel base course.

Areas deficient in density or stability or having a tendency to ravel, shall be repaired as the Engineer may direct, and material that does not compact properly shall be replaced with suitable gravel.

3.1.2 STABILIZED BASE COURSE

Upon completion of the gravel base course, the Contractor shall place bituminous stabilized base course meeting the requirements for materials and construction as specified under appropriate sections, inclusive, of the State Highway Department Specifications for Road and Bridge Construction, latest revision, except as modified herein.

3.1.3 CASTINGS AND VALVE BOXES

The Contractor shall raise to final grade, prior to final paving, all casting except curb inlet type storm drainage castings that are within the area to receive the one (1) inch overlay of bituminous concrete pavement. The top course pavement shall be feathered down to and around the storm drainage casting from a minimum distance of two (2) feet.

3.1.4 TOP COURSE

The Contractor shall place bituminous concrete HMA 9.5 M64 meeting the requirements for materials and construction of the New Jersey State Highway Department Standard Specifications for Road and Bridge Construction, latest revision. Bituminous concrete pavement shall consist of an overlay of Hot Mix Asphalt to the limits indicated on the drawings. Prior to final paving, all depressions shall be brought to grade by use of a leveling course. A tack coat shall be applied to the existing road surface prior to final paving. Tack coat material shall be cutback asphalt conforming to the requirements of the State specifications applied at a rate of 0.10 gallons per square yard. Methods of construction and equipment used shall conform to applicable State specifications.

3.1.5 TRAFFIC LINES AND MARKINGS

All traffic lines and markings shall be replaced and installed where previously located on all new pavement affecting lane lines, stop bars, cross walks, edge lines in accordance with NJDOT Standards utilizing Thermoplastic and reflectorized paint.

SECTION 02 06 00
DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders and General Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The scope of work under this section includes all labor and incidentals for the demolition and disposal of existing building elements as detailed on the drawings and specified in the specifications, and as otherwise required to accomplish all of the work shown on the drawings.
B. Work Included: The intent of the demolition work is to provide all demolition required to implement the alteration and addition work delineated on the drawings. The demolition work includes, but is not limited to:
    1. Saw cutting and removal of sections of concrete slabs
    2. Removal of existing lintels and sawcutting of existing masonry wall to enlarge existing openings.
    3. Removal of finishes within the existing building
    4. Removal of existing roofing and insulation
    5. Removal of wood frame roof and ceiling construction
    6. Temporary support and/or removal and protection of elements scheduled to remain
    7. Removal of doors, door frames, and door hardware
    8. Removal of existing windows and modifications to existing openings to facilitate the new work
    9. Removal of framing
    10. Removal of existing furnishings, wall obstructions, casework, millwork, partitions, kitchen equipment, hydronic heating piping and covers, wall base, trim, etc.
    11. Removal of exterior site improvements such as concrete walks, landscaping, planter borders, rock and gravel, dirt and excavation
    12. Removal of mechanical, electrical and plumbing elements as set forth in the Mechanical, Electrical, and Plumbing sections of this specification and as delineated on the drawings.
    13. Disposing of debris
    14. Final cleanup

1.3 QUALITY ASSURANCE

A. Comply with all applicable requirements of the State of New Jersey and applicable County ordinances and regulations concerning management of demolition and disposal of debris.

1.4 PROTECTION

A. Protect existing finishes and infrastructure which are to remain after the work in this Section is completed. Repair items, which are to remain, and which were damaged during the performance of the work to their original condition or replace with new.

1.5 TEMPORARY SHORING

A. Shoring System Designed by Others: Temporary shoring required for temporary support of the existing structure to facilitate the rehabilitation work delineated on the drawings is the responsibility of the Contractor. Temporary shoring systems must be designed by a licensed New Jersey Professional Engineer or Architect and three (3) sets of signed/sealed drawings and structural calculations must be submitted for review and approval prior to erection of the shoring system.

PART 2 - (NOT USED)

PART 3 - EXECUTION

3.1 STRUCTURE

A. The Contractor is responsible for the design, strength, adequacy, safety and means and methods of construction of shoring and temporary bracing of Structure at all stages of erection, until such time that permanent members and construction are in place and final connections are completed.
B. Demolition and construction debris shall be removed from the construction area daily or placed in dumpsters, which must be removed from the site when filled.
C. Disassemble and remove all items attached to or built into walls scheduled for removal. This shall include all finishes and accessories.
D. During demolition operation take precautions to avoid damaging any active water supply lines, sprinkler system components, structural components, electrical components, HVAC components. or existing construction and equipment scheduled to remain.

3.2 DISPOSITION OF MATERIAL

A. Immediately relocate, recycle, or dispose of all other demolished material away from site.
B. Except where specified in other Sections, all materials and equipment removed and not reused, become property of the Contractor and shall be removed from the property. Title to materials, resulting from demolition, and materials and equipment to be removed, are vested in the Contractor.
C. Disposal of Rubbish and Debris: Dispose of all rubbish and debris in accordance with the requirements specified herein and in accordance with applicable laws and ordinances.

3.3 DEBRIS REMOVAL AND DISPOSAL

A. All debris shall be removed from the construction site and legally disposed. Debris shall be removed from the construction site as demolition operations progress either by truck or dumpster. Debris shall not be allowed to accumulate on or near the construction site. If debris is to be removed from the construction site utilizing dumpsters, debris may be stored in the dumpsters until full. However, full dumpsters shall not be allowed to remain on the site in authorized staging area designated by the owners.
B. Upon completion of demolition work, remove tools, equipment and other unnecessary materials from the site. Remove protections and leave the area broom clean. Repair and clean adjacent construction or surfaces soiled or damaged by selective removal work.
C. No material to shall be burned on site.
D. All work shall comply with all safety requirements of the State of New Jersey and Standard Number 241 “Safeguarding Building Construction and Demolition Operations” current edition, of the National Fire Protection Association.
E. The use of any and all open flame devices is not permitted on this project without prior approval.
F. Where equipment might cause a fire is used, keep fire extinguishers ready within 50ft. of the work site for instant use. Fire extinguishers shall be visible and not concealed within vehicles. Users of such equipment shall be instructed in the proper method to prevent fires and to extinguish a fire.
G. During demolition operation take precautions to avoid damaging any active water supply lines, structural components, electrical components, HVAC components, or walls scheduled to remain.

3.4 STORAGE

A. Materials salvaged for reuse shall be stored by the Contractor at the site of the work. All materials scheduled to be dismantled or relocated for re-installation shall be clearly labeled by the Contractor to facilitate re-assembly at the original or new location.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
B. Scope: Provide all materials, labor, equipment, and appliances required to complete work of this Section, including, but not necessarily limited to, the following:
   1. Footings
   2. Piers
   3. Interior Slabs
   4. Exterior Slabs
   5. Repairs to Concrete after Demolition
   6. Miscellaneous repairs to existing concrete

C. Related Sections include the following:
   1. Section 07 92 00 - Joint Sealants

1.3 REFERENCES

A. Codes and Standards: Comply with provisions of the latest editions of the following Codes, specifications and standards, except where more stringent requirements are shown or specified:
   1. ASTM…….. American Society of Testing and Materials “Listed Standard”
   2. ACI 301…… "Specifications for Structural Concrete for Buildings"
   3. ACI 318…… "Building Code Requirements for Reinforced Concrete"
   4. CRSI……. Concrete Reinforcing Steel Institute, "Manual of Standard Practice"
   5. NJDOT……. New Jersey Department of Transportation “Standard Specifications”

1.4 QUALITY ASSURANCE

A. Concrete Testing Service: Employ, at Contractor's expense, a testing laboratory classified approved by the Architect to evaluate concrete mixes and perform material evaluation tests related to the concrete mixes. Materials and installed work may require testing and retesting, as directed by Architect, at any time during the progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by Architect.
B. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design tests.
C. Material Certificates: Provide materials certificates for cement, aggregates, admixtures, reinforcing, welded wire fabric, non-shrink grout, curing compounds and non-slip aggregates. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

D. Concrete Mix Designs: Provide mix designs with strength tests for each class and type of concrete for review by the Architect prior to placement of concrete.
E. Reinforcement Shop Drawings: Provide reinforcement shop drawings for review and approval by the Architect prior to placement of concrete.
F. Concrete Testing Agency per Section 01 45 23.

PART 2 PART 2 – PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal framed plywood faced or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system when shown on drawings. Provide form material of sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
C. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
D. Use flexible spring steel forms or laminated boards to form radius bends.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ANSI/ASTM A 615, Grade 60, deformed.
B. Steel Wire: ANSI/ASTM A 82, plain, cold drawn, steel.
C. Welded Wire Reinforcement (WWR): ANSI/ASTM A185-01, size as specified on drawings.
D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise acceptable. Utilizing hooks to raise WWR in place is NOT ACCEPTABLE.
E. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ANSI/ASTM C 150 for Type I or ASTM C-595 for Type IL, Conforming to Section 914 of NJDOT Standard Specifications. Use one brand of cement throughout project, unless otherwise acceptable to Architect.
B. Portland Cement Substitutes: Not Permitted. This includes fly ash, slag cement, calcined clay, and silica fume.
C. Aggregates:
    1. Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
    2. Local aggregates not complying with ANSI/ASTM C 33, but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Architect.
    3. Lightweight Aggregates: ASTM C 330

D. Water: Potable.
E. Air Entraining Admixture: ANSI/ASTM C 260.
F. Products: Subject to compliance with requirements, provide one of the following:
    1. "Air Mix" or "Perma Air"; Euclid Chemical Co.
    2. "Daravair"; Grace Construction Products.
    3. "MB VR" or "MB AE 90"; Master Builders
    4. "Sika AER"; Sika Chemical Corp.

5. Or approved equal

G. Water Reducing Admixture: ANSI/ASTM C 494, Type A, and contain not more than 0.05% chloride ions. Products: Subject to compliance with requirements, provide one of the following:
   1. "Eucon WR 75"; Euclid Chemical Co.
   2. "WRDA with Hycol"; Grace Construction Products
   3. "Pozzolith 220N"; "MBL-82" or "Polyheed 997"; Master Builders Inc.
   4. "Plastocrete 161"; Sika Chemical Corp.
   5. Or approved equal

H. Mid-Range Water Reducing Admixture: ANSI/ASTM C 494, Type A & F and contain not more than 0.05% chloride ions. Products: Subject to compliance with requirements, provide one of the following:
   1. “EUCON X-15” or “EUCON MR”; Euclid Chemical Company
   2. “Sikament AFM” or “Sikaplast 500”; Sika Corporation
   3. “WRDA 64”; Grace
   4. “MasterPolyheed 900”; BASF Corporation
   5. Or Approved equal

I. Non Corrosive, Non Chloride Accelerator Admixture: ASTM C 494, Type C or E, and contain no more chloride ions than are present in municipal drinking water. The manufacturer must have long term test data (at least a year), from an independent testing laboratory, concerning corrosion using an acceptable accelerated corrosion test method such as that using electrical potential measures. Products: Subject to compliance with requirements, provide one of the following:
   1. "Accelguard 80"; Euclid Chemical Co.
   2. "Daraset"; Grace Construction Products
   3. "Pozzolith NC-534" or " Pozzutec 20"; Master Builders Inc.
   4. "Plastocrete 161FL"; Sika Chemical Corp.
   5. Or approved equal

J. Water Reducing, Retarding Admixture: ASTM C 494, Type D, and contain not more than 0.05% chloride ions. Products: Subject to compliance with requirements, provide one of the following:
   1. "Eucon Retarder 75"; Euclid Chemical Co.
   2. "Daratard 17"; Grace Construction Products
   3. “Pozzolith 100XR", "Pozzolith 122R" or "Polyheed RI"; Master Builders Inc.
   4. "Plastiment"; Sika Chemical Co.
   5. Or approved equal

K. Calcium chloride, or admixtures containing more than 0.05% chloride ions are not permitted. Thiocyanate-based chemical admixtures shall contribute less than 0.30% thiocyanate ions by weight of cement when the manufacturer's maximum recommended dosage is used. Certification of conformance to the above-mentioned requirements and the chloride content of the admixture will be required from the admixture manufacturer prior to review of mix design.

2.4 RELATED MATERIALS

A. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
   1. "Eucobar,"; Euclid Chemical Co.
   2. "E Con"; L&M Construction Chemicals, Inc.
   3. "Confilm"; Master Builders, Inc.
   4. "SikaFilm"; Sika Chemical Corp.
   5. Or approved equal

B. Liquid Membrane Forming Curing and Sealing Compound: Water-based acrylic type, 30% solids content minimum, and have test data from an independent testing laboratory indicating a maximum moisture loss of 0.55 kg per sq m in 72 hours when applied at the coverage rate recommended by the manufacturer. Products offered by manufacturers to comply with the requirements for membrane forming curing and compounds include the following:
   1. "Super Diamond Clear VOX"; The Euclid Chemical Corp.
   2. "Mastercure 200W"; Master Builders
   3. "Dress & Seal #30 WB"; L&M Construction Chemicals Inc.
   4. Or approved equal

C. Bonding and Repair Materials: Bonding Materials: Polyvinyl acetate, rewettable type. Use only in areas not subject to moisture.
   1. "Euco Weld"; Euclid Chemical Co.
   2. "Weldcrete"; Larsen Co.
   3. Sikaliquid Weld; Sika Chemical Corp.
   4. Or approved equal

D. Epoxy Adhesive: The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces:
   1. "Euco Epoxy" #452MV or #620; Euclid Chemical Co.
   2. "Sikadur 32,Hi Mod"; Sika Chemical Corp.
   3. "Concresive Liquid LPL"; Master Builders
   4. Or approved equal

E. Polymer Patching Mortar: Free flowing, polymer modified cementitious coating.
   1. "Euco Thin Coat" or "Verticoat LPL"; Euclid Chemical Co.
   2. "Sikatop 121, 122, or 123"; Sika Chemical Corp.
   3. "Emaco 300, 310, or 350"; Master Builders
   4. Or approved equal

F. Bonding Admixture: The compound shall be a latex, non rewettable type.
   1. "SBR Latex" or "Flex con"; Euclid Chemical Co.
   2. "Daraweld C"; W. R.Grace
   3. "MB Primer"; Master Builders
   4. "SikaLatex" or "SikaLatex R"; Sika Chemical Corp.
   5. Or approved equal

G. Joint Filler for construction joints: Closed cell polyurethane 1/2" thick unless otherwise noted on drawings. Include tear strip as required for installation of joint sealant where required.

H. Vapor Barrier: .006” (6 mil.) minimum Polyethylene vapor barrier.

I. Concrete Patching Repair Mortar: 1-component, rapid hardening, early strength gaining, cementitious, patching material for concrete. Compressive Strength per ASTM C-109 = 4,000psi in 1 day and 7,000 psi in 28 days. Bond strength per ASTM C-882 = 2,500psi at 28 days. Drying Shrinkage per ASTM C-596 = 0.06.

J. Coating for Exposed Reinforcing Bars: Bonding Primer and Reinforcement Corrosion Protection shall be a cementitious epoxy resin compensated 3-component, solvent free, coating material with corrosion inhibitor with tensile adhesion strength of 625 psi per ASTM C-1583 and slant shear strength of 2,800 psi wet-on-wet and 2,600 psi 24 hour open time per ASTM C-882. Sika Armatec – 110 EpoCem, Master Builders MasterEmaco P 124, ChemMasters Polyweld-EPX, or approved equal.

K. Perimeter Insulation: Extruded Polystyrene Board Insulation. Rigid, closed-cell extruded polystyrene insulation board complying with ASTM C578, Type IV, minimum 25 psi compressive strength, R-5 per inch of thickness. Maximum water absorption pf .10 % by volume. Water vapor permeance of 1.5 perm. Provide in manufacturer's standard lengths and widths.

L. Under-Slab Waterproofing Membrane: Provide under slab waterproofing membrane / vapor barrier under all new concrete floor slabs within the perimeter of the building exterior walls. Underslab membrane shall be minimum 85 mil sheet membrane with a double-thickness, cross-laminated, high-density polyethylene (HDPE)

backing laminated to a thick layer of proprietary waterproofing adhesive compound integrated into a high-strength, nonwoven geotextile fabric. On the fabric side, a four (4) inch-wide lap of waterproofing adhesive compound is left exposed along one edge with a removable silicone coated release sheet, which creates a four (4) inch-wide self-adhesive overlap seam. Provide all accessories from the same manufacturer as the membrane including adhesives, seam tape, liquid membrane, prefabricated corner boots, and detailing sealants.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Design Mix Meeting: Prior to the preparation of any design mix containing high range water reducing admixture, a meeting shall be held. The purpose of the meeting is to assure that all parties involved are aware of all of the requirements pertaining to the use of this type of concrete to assure that quality concrete is obtained. The meeting shall be attended by the Contractor, Concrete Subcontractor (if any), Concrete Supplier, Pumping Subcontractor (if any), Testing Laboratory preparing design mix and the Admixture Manufacturer's Representative.
B. Prepare design mixes for each type and strength of concrete by either laboratory the trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to Architect. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect. If trial batch mixes are used, the mix design shall achieve an average compressive strength 1,200 psi greater than the specified strength.
C. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.
D. Design mixes to provide lightweight and normal weight concrete with the following properties, as indicated on drawings and schedules:
    1. Normal weight Concrete for Building Construction and Site Improvements: 4,000 psi 28-day compressive strength. Minimum cement content: 580 lbs/cu.yd; Maximum Water/cement ratio: 0.44.

E. 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; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.
F. Use water reducing admixture or high range water reducing admixture (super plasticizer) in all concrete.
G. Use non corrosive accelerating admixture in concrete slabs placed at ambient temperatures below 50ºF.
H. Use air entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
    1. Concrete structures exposed to freezing and thawing or subjected to hydraulic pressure, and slabs 6% for 3/4" - 1" aggregate and 7% for 1/2” - 3/8” aggregate.
    2. Interior Concrete slabs: No added air entrainment.
    3. Other Concrete: 2% to 4% air.

I. Use admixtures for water reducing and set control in strict compliance with manufacturer's directions.
J. Slump Limits: Proportion and design mixes to result in concrete slump at truck as follows:
    1. Ramps and sloping surfaces: Not more than 3".
    2. Reinforced foundation systems: Not less than 1" and not more than 3".
    3. Concrete containing HRWR admixture (super plasticizer): Not more than 8" after addition of admixture nor more than 3" prior to addition of admixture.
    4. Other concrete: Not less than 1" and not more than 4"

2.6 CONCRETE MIXES

A. Ready Mix Concrete: Comply with requirements of ANSI/ASTM C 94 and as herein specified.
B. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.
C. Redosage with the specified high range water reducing admixture may be done with the prior approval of the Architect regarding dosage and time periods.

D. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ANSI/ASTM C 94 may be required.
E. When air temperature is between 85oF and 90oF, reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90oF, reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.1 FORMS

A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
B. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back up at joints to prevent leakage of cement paste.
C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
E. Chamfer exposed corners and edges, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
F. Form Ties: Factory fabricated, adjustable length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spilling concrete surfaces upon removal.
G. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1 1/2" inside concrete. Unless otherwise shown, provide form ties which will not leave holes larger than 1" diameter in concrete surface.
H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
C. Accurately position, support and secure reinforcement (including welded wire fabric) against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and tie splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect and at a maximum of 25’-0” in any direction.
B. Provide keyways at least 1 1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
C. Place construction joints of members perpendicular to the main reinforcement. Continue reinforcement across construction joints or structural members.
D. Isolation Joints in Slabs on Ground: Construct isolation joints in slabs on ground at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.
E. Sealant materials are specified in Section 07 92 00 of these specifications.
F. Contraction (Control) Joints in Slabs on Ground: Construct contraction joints in slabs on ground to form panels of patterns as shown by saw cutting or by inserting an approved plastic strip into fresh concrete until the top surface of the strip is flush with the slab surface.
G. Install plastic strip into concrete using tool recommended by manufacturer. Prior to the concrete being floated, remove the top section of the insert. If saw cutting is used, "Soff-Cut" saw shall be used immediately after final finishing and to a depth of 1".

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast in place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike off templates or accepted compacting type screeds.

3.5 PREPARATION OF FORM SURFACES

A. Coat contact surfaces of forms with a form coating compound before reinforcement is placed.
B. Thin form coating compounds only with thinning agent of type, and in amount, and under conditions of form coating compound manufacturer's directions. Do not allow excess form coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
C. Coat steel forms with a non staining, rust preventative form oil or otherwise protect against rusting. Rust stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
C. General: Comply with ACI 304, and as herein specified.
D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
E. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

F. Do not allow concrete to drop more than 5 feet in concrete which will be exposed to view. Do not allow concrete to drop more than 7 feet in concrete which will not be exposed.
G. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309 recommended practices.
H. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
I. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
J. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
K. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
L. Maintain reinforcing in proper position during concrete placement operations.
M. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. When air temperature has fallen to or is expected to fall below 40oF, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50oF, and not more than 80oF at point of placement. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Only the specified non corrosive non chloride accelerator shall be used. Calcium chloride, thiocyanate or admixtures containing more than 0.05% chloride ions are not permitted.
N. Hot Weather Placing: When high temperatures, low humidity and dry winds create conditions suitable for plastic cracking, the evaporation retarder "Eucobar" by The Euclid Chemical Co. or "Confilm" by Master Builders may be required to be applied by spray one or more times during the finishing operation. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90oF. Mixing water may be chilled or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing. Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Wet forms thoroughly before placing concrete. Use water reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

3.7 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified.
B. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both Consolidate surface with power driven floats, or by hand floating is area is small or inaccessible to power units. Check and level surface plane to a tolerance of Ff20/Fll17. Cut down high spots and fill low spots, refloat surface to a uniform, smooth, granular texture.
C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin-film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a 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, and with a surface leveled to a tolerance of FF25/FL20. Surface defects that would telegraph through applied floor covering system are to be ground smooth.
D. Non-Slip Aggregate Finish: Apply non-slip aggregate finish to all exterior concrete steps. After completion of float finishing and before starting trowel finish, uniformly spread 25 lbs. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.

After broadcasting and tamping, apply trowel finishing as herein specified. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non-slip aggregate.

E. Non-Slip Broom Finish: Apply non slip broom finish to exterior concrete platforms, walks and ramps, and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.8 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by. moisture retaining cover curing, and by combinations thereof, as herein specified

D. Provide moisture curing by following methods.

E. Keep concrete surface continuously wet by covering with water. Use continuous water fog spray. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.

F. Provide moisture cover curing as follows:

G. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

H. Provide curing and sealing compound to exposed interior slabs and to exterior slabs, walks, and curbs as follows:

I. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete

J. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

K. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.

L. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture retaining cover, unless otherwise directed.

3.9 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50oF for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joints, slabs, and other structural elements, may not be removed until concrete has attained design compressive strength (f'c) but in no case shall the forms be removed in less than 14 days. Determine potential compressive strength of in place concrete by testing field cured specimens representative of concrete location or membrane.

C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.10 RE USE OF FORMS

A. Clean and repair surfaces of forms to be re used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in place construction. Provide other miscellaneous concrete filling shown or required to complete work.
B. Grout Application: All column base and leveling plates, beam bearing plates, elevator equipment and sills, equipment bases, and other locations noted on the drawings shall be grouted with the specified non shrink grout.
C. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

3.12 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
B. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried. For exposed to view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
C. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spills, air bubbles, honeycomb, rock pockets, fins, and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
D. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
E. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
F. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same

type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

G. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

H. Repair methods not specified above may be used, subject to acceptance of Architect.

3.13 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Contractor shall employ a testing laboratory approved by the Architect to inspect formwork and reinforcement, test concrete and to submit test and inspection reports. All technicians used on the project shall have successfully completed the ACI concrete technician course. The testing laboratory shall certify that the technicians used on this Project meet this requirement.

B. The Contractor is responsible to assure that each concrete truck load is delivered with a weighted batch ticket indicating the actual quantities of each component of the mix included in the load. The testing technician shall obtain a copy of the weighted batch ticket for each truck and include in their report. This will be utilized to verify that the concrete delivered is the approved design mix for the placement and to allow for tabulation of water cement ratio if any water is to be added to the load prior to placement. The Contractor and the testing technician are to assure that no additional water is added to the mix once placement has commenced.

C. Sampling and testing for quality control during placement of concrete shall include the following for each truck at point of delivery:
   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   2. Slump: ASTM C 143; one test for each concrete truck load at point of discharge prior to placement of the concrete in forms. If Super Plasticizer is used, conduct an additional slump test after Super Plasticizer is introduced and mixed.
   3. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure for normal weight concrete; one for each set of compressive strength test specimens. Air content shall be tested for each concrete truck load prior to placement of the concrete in forms.
   4. Concrete Temperature: Test each load of concrete prior to placement in forms.
   5. Compression Test Specimen: ASTM C 31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cure test specimens are required.
   6. Compressive Strength Tests: ASTM C 39; one set for each concrete truck load regardless of quantity, with 2 specimens tested at 7 days, 3 specimens tested at 28 days, and 1 specimen retained in reserve for later testing if required. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

D. Test results shall be reported in writing to the, Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete slump, air content and temperature at time of placement; compressive breaking strength and type of break for both 7 day tests and 28 day tests.

E. Inspection Results shall be reported in writing to Architect and Contractor on same day that inspections are made. Reports shall contain location, size, grade, spacing, and form clearance of reinforcing, slump, temperature of concrete, air temperature, and air content. Condition of forms shall be noted on the report. The Architect and Contractor are to be notified verbally at the time of inspection of deviations from approved drawings so that the reinforcing and mix may be corrected prior to concrete placement. Report shall note all deviations which were not corrected prior to concrete placement.

F. If specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. The Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

G. Compression testing and sampling is required for all concrete and grout.

H. Testing agency shall be present throughout placement of concrete and indicate in their report the time of completion of off loading.

I. The testing agency technician shall compare delivery and batch tickets with design mix and indicate compliance in their report and include a copy of the weighted batch ticket with the report. Refer to Article 3.13(B) above.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the following:
   1. Concrete unit masonry
   2. Clay unit masonry
   3. Setting loose lintels
   4. Building in flashings
   5. Precast lintels
   6. Parging
   7. Installation and grouting of door frames

1.3 RELATED WORK

A. The following similar work is specified under other sections:
   1. Metal flashing is specified in Section 07 62 00 "Flashing and Sheet Metal".
   2. Hollow metal frames in unit masonry openings are specified in Section 08 11 01 "Steel Doors and Frames".
   3. Steel Lintels are specified in Section 05 12 00 Structural Steel.
   4. Flood vents for installation in masonry walls are specified in Section 08 95 43.

1.4 SUBMITTALS

A. Product data for each different masonry unit, accessory, and other manufactured product indicated.
B. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

1.5 REFERENCES

A. Codes and Standards: Comply with provisions of the latest editions of the following Codes, Specifications and Standards except where more stringent requirements are shown or specified.
   1. ACI 531 "Building Code Requirements for Concrete Masonry"
   2. ACI 530.1/ASCE 6 "Specifications for Masonry Structures,"
   3. ACI 530/ASCE 5 "Building Code Requirements for Concrete Masonry"
   4. ACI 530.1/ASCE 6 "Specifications for Masonry Structures,"
   5. ACI 315 "Details and Detailing of Concrete Reinforcing"
   6. NCMA TEK No. 11A "Reinforced Hollow Unit Concrete Masonry"
   7. NCMA TEK No. 20A "Mortars for Concrete Masonry"
   8. NCMA TEK No. 23A "Grouting for Concrete Masonry Walls"
   9. NCMA TEK No. 36A "ASTM Specifications for Concrete Masonry Units"
   10. NCMA TEK No. 59 "Reinforced Concrete Masonry Construction"
   11. NCMA TEK No. 62 "Concrete Masonry Cavity Walls"
   12. NCMA TEK No. 63 "Partially Reinforced Concrete Masonry Walls"
   13. NCMA TEK No. 71 "Cold Weather Construction with Concrete Masonry"
   14. NCMA TEK No. 79 "Concrete Masonry Veneers"

15. NCMA TEK No. 81 "Lintels for Concrete Masonry Walls"
16. NCMA TEK No. 92 "Control and Removal of Efflorescence"
17. BIA Technical Notes 1- All Weather Construction
18. BIA Technical Notes 2- Glossary of Terms
19. BIA Technical Notes 3a- Material Properties
20. BIA Technical Notes 3b Section Properties
21. BIA Technical Notes 7a- Water Resistance – Materials
22. BIA Technical Notes 7a- Water Resistance – Construction
23. BIA Technical Notes 8- Mortars for Brick Masonry
24. BIA Technical Notes 9a- Manufacturing, Classification of Brick
25. BIA Technical Notes 7a- Water Resistance – Materials
26. BIA Technical Notes 11a- thru e- Guide Specs
27. BIA Technical Notes 14a -Brick Floors and Pavements – Materials and Installation
28. BIA Technical Notes 14b -Brick Floors and Pavements
29. BIA Technical Notes 15 -Salvaged Brick
30. BIA Technical Notes 20- Cleaning Brick
31. BIA Technical Notes 28- Anchored Brick Veneer, Wood Frame
32. BIA Technical Notes 28a- Brick Veneer, Existing Construction
33. BIA Technical Notes 31b- Structural Steel Lintels
34. BIA Technical Notes 36- Details, Sills and Soffits
35. BIA Technical Notes 36a- Details, Caps Copings, Corbels and Racking
36. BIA Technical Notes 44- Anchor Bolts
37. BIA Technical Notes 44a- Fasteners
38. BIA Technical Notes 44b- Wall Ties

1.6 QUALITY ASSURANCE

A. Testing:
   1. Testing Service: Employ, at Contractor's expense, a testing laboratory approved by Architect to perform material evaluation tests related to the Masonry Construction. Materials and installed work may require testing and retesting, as directed by Architect, at any time during the progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.
   2. Construction Testing: Compressive strength of grout shall be conducted daily during construction for each 5,000 sq. ft. of wall area or portion thereof. Grout properties shall be tested per ASTM C 270. Mortar Composition and properties shall be tested per ASTM C 780.
   3. Compressive strength test of concrete fill in pilasters shall be in accordance with the requirements of Section 03 30 00 Cast-in-Place Concrete.

B. Fire Performance Characteristics
   1. Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

C. Single-Source Responsibility
   1. Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
   2. Mortar Materials: Obtain mortar ingredients of uniform quality, including color to exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Performance Requirements
   1. 28-day compressive strength of concrete masonry, f'm: 1,500 psi

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.
B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.
C. Store cementitious materials off the ground, under cover, and in dry location.
D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that comes in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

D. Cold-Weather Construction: Comply with referenced unit masonry standard for cold-weather construction and the following:
   1. Do not lay masonry units that are wet or frozen.
   2. No frozen work shall be built upon and no masonry unit having a film of water or frost on its surface shall be laid.
   3. Cease installation of masonry work during continuous rain. Protect fresh masonry work from rain by protective coverings.
   4. The mortar shall properly harden without freezing and no damage from frost shall occur. No anti-freezing ingredient shall be mixed with the mortar. In freezing weather all recently built work shall be protected. Any completed work found to be affected by the frost shall be taken down and rebuilt by the Contractor without cost to the Owner. No materials which are frozen or covered with ice and snow shall be used in construction.

E. Hot-Weather Construction: Comply with referenced unit masonry standard.

PART 2 – PRODUCTS

2.1 CLAY MASONRY UNITS

A. Face Brick Standard: ASTM C 216 and as follows:
   1. Grade and Unit Compressive Strength: Provide units of grade and minimum average net area compressive strength indicated below:
      a. Grade SW
      b. 3,000 psi

   2. Type FBS
   3. Size: Provide bricks manufactured to the following actual dimensions within the tolerances specified in ASTM C216: Modular Size: 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long. Verify in field.
   4. Application: Walls
   5. Products: To match existing brick in color and texture as closely as possible.

B. Building (Common) Brick: ASTM C 62, and as follows:
   1. Grade and Unit Compressive Strength: Provide units of grade and minimum average net area compressive strength indicated below:
      a. Grade SW
      b. 3,000 psi

   2. Size: Provide bricks manufactured to the following actual dimensions within the tolerances specified in ASTM C216 Standard Modular: 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long

2.2 CONCRETE MASONRY UNITS

A. General: Concrete Masonry Units shall be manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
B. Concrete Building Bricks: Normal weight or lightweight units, ASTM C 55, Type I, moisture-controlled units to specified dimensions by 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long, with a minimum average net area compressive strength of 3,500 psi.
C. Hollow Load-Bearing Concrete Masonry Units:
   1. Exterior Walls: Medium weight units, ASTM C-90, Grade N-1, with a minimum average net area compressive strength of 1,900 psi
   2. Interior Walls: Lightweight units, ASTM C 90, Grade N or S, with a minimum average net area compressive strength of 1,900 psi
   3. Below Grade: Normal weight, ASTM C 90, Grade N-1, with a minimum average net area compressive strength of 1,900 psi

D. Solid Load-Bearing Concrete Masonry Units: ASTM C 90, Grade N, with minimum average net area compressive strength of 1,800 psi

2.3 MORTAR AND GROUT MATERIALS AND MIXES

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color. For colored aggregate mortars use masonry cement of natural color or white, as required to produce mortar color indicated.
B. Hydrated Lime: ASTM C 207, Type S
C. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve. White Mortar Aggregates. Natural White sand or ground white stone.
D. Water: Clean and Potable

E. General: Do not add admixture including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. **Do not use calcium chloride in mortar or grout**.
F. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar specified. Use type M mortar for all foundation walls and below grade construction. Use Type S mortar for all above grade construction.
G. Grout for Unit Masonry: Course Grout complying with ASTM C 476 and referenced unit masonry standard for cavities with a minimum of 4" horizontal dimension, fine grout complying with ASTM C 476 for cavities less than 4" and 3000 psi concrete with maximum 1" aggregate for space greater than 6".

2.4 REINFORCING STEEL

A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this Section.
B. Steel Reinforcing Bars: Material and grade shall be billet steel complying with ASTM A 615, Grade 60
C. Deformed Reinforcing Wire: ASTM A 496
D. Plain Welded Wire Fabric: ASTM A 185
E. Deformed Welded Wire Fabric: ASTM A 497

2.5 JOINT REINFORCEMENT

A. General: Provide joint reinforcement complying with requirements of referenced unit masonry standard and this article, formed from hot dipped galvanized carbon steel wire, coating class as required by referenced unit masonry standard for application indicated.
B. Description: Welded-Wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below.
    1. Wire Diameter for Side Rods: 0.1875 inch
    2. Wire Diameter for Cross Rods: 0.1875 inch
    3. For single-wythe masonry provide type as follows with single pair of side rods: Truss design with continuous diagonal cross rods spaced not more than 16 inches o.c.
    4. For multiwythe masonry provide type as follows: Truss design with diagonal cross rods spaced not more than 16 inches o.c. and number of side rods as follows: Number of Side Rods for Multiwythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches in nominal width plus one side rod for each wythe of masonry 4 inches or less in nominal width. Tab design with single pair of side rods and rectangular box-type cross ties spaced not more than 16 inches o.c.; with side rods spaced for embedment within each face shell of backup wythe and ties extended to engage the outer wythe by at least 1-1/2 inches. Use units with adjustable 2-piece rectangular ties where horizontal joints of facing wythe do not align with those of backup and where indicated.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering joint reinforcement that may be incorporated in the Work include, but are not limited to, the following:
    1. Dur-O-Wal, Inc.
    2. Heckman Building Products, Inc.
    3. Hohmann & Barnard, Inc.
    4. National Wire Products Industries

2.6 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.
B. Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard for application indicated. Wire shall be 0.1875 inch. Diameter.
C. Galvanized Steel Sheet: As follows:

1. ASTM A 526 (commercial quality), Coating Designation G60, steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication, for sheet metal ties and anchors completely embedded in mortar.
2. ASTM A 366 (commercial quality) cold-rolled carbon steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors exposed to the weather and not completely embedded in mortar and grout.
3. Galvanized Steel Sheet Thickness: For steel sheet hot-dip galvanized by continuous process prior to fabrication:
    a. 0.0635 inch (16 gage)
    b. 0.0785 inch (14 gage)
    c. 0.1084 inch (12 gage)

D. Steel Plates and Bars: ASTM A 36, shop painted with 2 coats of coal-tar epoxy-polyamide paint complying with SSPC Paint-16 to comply with SSPC-PA1 ("Paint Application Specification No. 1") and SSPC-SP6 ("Commercial Blast Cleaning") for surface preparation.

2.7 BENT WIRE TIES

A. Individual unit prefabricated from bent wire to comply with requirements indicated below:
B. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with closed ends and not less than 4 inches wide.
C. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long.
D. Type for Masonry Where Coursing between Wyths Align: Unit ties bent from one piece of wire.
E. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.
F. Type for Securing Cavity Insulation: Consisting of separate pintle and eye sections for tying wall wyths and securing insulation.

2.8 ADJUSTABLE ANCHORS FOR CONNECTING MASONRY TO STRUCTURAL MEMBERS

A. General: Two-piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.
B. For anchorage to steel members provide manufacturer's standard anchors with crimped 1/4-inch-diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1 inch of masonry face.

2.9 RIGID ANCHORS

A. Provide straps of form and length indicated, fabricated from metal strips of following width and thickness. 1-1/2 inches wide by 1/4 inch thick.

2.10 MISCELLANEOUS ANCHORS

A. Unit Type Masonry Inserts in Concrete: Cast iron or malleable iron inserts of type and size indicated.
B. Dovetail Slots: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336-inch (22-gage) sheet metal.
C. Anchor Bolts: Steel bolts complying with A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in size and configurations indicated.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Nonmetallic Expansion Joint Strips: Premolded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated, formulated from neoprene.
B. Perforated Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated: Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation 2AA-805.
C. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
D. Weep Vents: Hohmann & Barnard Inc. #342 3/8” x 1 ½” x 3 ½”

2.12 THROUGH-WALL-FLASHING

A. All through-wall-flashing shall be three-way bond interlocking type fabricated from .018 stainless steel. Flashing shall be formed to provide a mechanical bond in the mortar bed in three directions. Bonding features shall consist of 3/16" high undercut sawtooth ribs spaced at not more than 3" intervals.

2.13 MORTAR MESH

A. Provide trapezoidal shaped mortar net to suspend mortar droppings at unequal heights allowing moisture to drain from the cavity and maintain airflow within the cavity wall. The trapezoidal shaped mesh with is a 90% open mesh, 2” polyester, 1” or 0.4” nylon thickness. The insect barrier is a densely weaved membrane attached to the face of the Mortar Net. Install per manufacturer’s instructions.

2.14 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.

2.15 PRECAST LINTELS

A. General: Precast concrete lintels shall be the product of a concern regularly engaged in the manufacturing of same and shall be as detailed on the drawings.
B. Concrete Mix: 3,000 psi, 28 days
C. Reinforcing Steel: ASTM 615 grade 60
D. Shop Drawings: Prior to proceeding with fabrication of precast lintels, submit for approval complete shop drawings. Shop drawings shall cover each type of lintel to be used and shall show the exact profile, steel reinforcement, loading capacity and Manufacturer's specification.
E. Marking and Identifications: Lintels shall be clearly marked and identified per lintel schedule on the plans, including type, size, reinforcing and "top of lintel".

PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.
B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
C. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

3.2 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of referenced unit masonry standard.

3.3 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
D. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.
E. Interior shear walls shall be bonded at the locations where they intersect exterior walls utilizing steel connectors having a minimum cross section of ¼" by 1 ½" with ends bent up at least 2" installed at 16" o/c vertically as well as with joint reinforcement. Steel connectors shall not be placed in the same courses as joint reinforcement. Rake back mortar joints at intersection and caulk.
F. Interior non-bearing walls shall be anchored to intersecting exterior walls and shear walls in accordance with Sub-section 3.3 E.
G. Interior non-bearing walls shall be anchored to other intersecting interior non-bearing walls with joint reinforcement or by overlapping 50% of the courses.
H. Joint reinforcement when used for anchorages shall be spaced at alternate block courses and be "tee" shaped and extend 30" in each direction. Longitudinal wires shall be at least wire size W1.7.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:
    1. With full mortar coverage on horizontal and vertical face shells.
    2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
    3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

B. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.
C. Nonbearing Interior Partitions: Build full height to underside of structural deck as shown on drawings.
D. Strike exterior joints on exterior walls flush.

3.5 GROUTING

A. Grouting shall be NCMA low lift. Filling voids in block as each course goes up, will not be acceptable.

3.6 HORIZONTAL JOINT REINFORCEMENT

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 8 inches.
B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
    1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
    2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
    3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 32 inches o.c. horizontally.

3.8 MOVEMENT (CONTROL AND EXPANSION) JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. If not indicated, control joints shall be provided at intervals not to exceed 25. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
B. Form control joints in concrete masonry as shown on drawings.
C. Do not extend horizontal deformed reinforcement in bond beams across movement joints. Install 36” smooth bars of the same diameter centered on joint.

3.9 LINTELS

A. Install steel lintels where indicated.
B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for block are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.
C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 PARGING

A. Parge predampened masonry walls where indicated with Type S or N Mortar applied in 2 uniform coats to a total thickness of 3/4 inch. Scarify first parging coat to ensure full bond to subsequent coat.
B. Use a steel-trowel finish to produce a smooth, flat dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
C. Damp cure parging for at least 24 hours and protect until cured.
D. Apply fluid applied polymer modified asphalts as manufactured by Tremco, Garland, W.R. Grace, or equal, accordance with manufacturer ‘s instruction.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Jointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.
C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
    1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
    2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
    3. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

3.12 REINFORCING

A. Install reinforcement as shown on plans. A minimum of one # 5 bar shall be installed at each side of all openings and at the ends of all walls. Lap splices in wall reinforcement shall be a minimum of 50 bar diameters.
B. All reinforcement is to be installed straight and be located centered in the cells unless shown or noted otherwise. Reinforcement is to be clean and free of any deleterious matter.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Instructions to Bidders, General and supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Extent of structural steel work is shown on drawings, including schedules, notes, and details to show size and location of members, typical connections and type of steel required.
B. Products furnished but not installed under this section:
   1. Anchor bolts for installation into masonry or concrete
   2. Loose base plates and bearing plates set on masonry or concrete
   3. Loose lintels

1.3 RELATED SPECIFICATION SECTIONS

A. The following Sections contain requirements that relate to this Section:
   1. Section 03 30 00 - Cast in Place Concrete
   2. Section 04 20 00 - Unit Masonry, for masonry anchors

1.4 SUBMITTALS

A. Submit the following for formal review and approval by the Architect according to Conditions of the Contract and Division 1 Specification Sections:
   1. Product Data: Submit manufacturer's specifications and installation instructions for the following products:
      a. High-strength bolts (each type), including nuts and washers.
      b. Structural steel primer paint
      c. Shrink resistant non-metallic grout
      d. Composite metal shear studs

   2. Shop Drawings:
      a. Prepared under direct supervision of New Jersey Registered Professional Engineer, including:
         1) Complete erection drawings, details and schedules for fabrication and shop assembly of members.
         2) Details, schedules, procedures, and diagrams showing sequence of erection.

      b. Indicate profiles, spacing and locations of members, including:
         1) Fabrication details
         2) Size and weight of members
         3) Location of shop and field connections
         4) Locations and details of anchors, base/bearing plates, and leveling plates
         5) Details of holes, cuts, camber, and splices
         6) Layout and location of composite shear studs
         7) Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

      c. Indicate welds by standard AWS A2.1 and A2.4 symbols distinguishing between shop and field welds; and show size, length, and type of each weld.

d. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorage to be installed as work by other sections.
e. Obtain detailed drawings of the Work by other trades including locations and sizes of openings in floors and roofs and the Work requiring holes in structural steel, mounting brackets, and supports attached to the structural steel.
f. Submit shop drawings in the phases, to coordinate with requirements of the Work. Identify phasing of the Work in Submittal Schedule as required by General Conditions.

3. Test Reports: Submit copies of required quality control test reports and inspections specified including tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.

B. Submit the following for information only according to Conditions of the Contract and Division 1 Specification Sections. The Architect will review but not approve, or disapprove, these submittals.
1. Mill Certificates: Provide fabricator's certification that the structural steel furnished for this Project complies with the requirements of the Contract Documents.
2. Mill Test Reports: Provide certified mill test reports of chemical analysis and physical test for each heat number of structural steel.
3. Welder's Certificates: Provide welder's certificates for welders employed for this Work, veriflying current AWS qualifications.
4. Galvanized Steel: Certification that steel to be galvanized contains elements within the ranges listed below:
a. carbon < 0.25%
b. phosphorus < 0.05%
c. manganese < 1.35%
d. silicon within the range 0 to 0.04% or 0.15 to 0.25%

1.5 PERFORMANCE REQUIREMENTS

A. Interface with other systems:
1. Coordinate primer with finish paint.
2. Provide templates and instructions for installing anchors in other Work.

B. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.
C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the latest editions of the following, except as otherwise indicated:

1. AISC Steel Construction Manual - Thirteenth including the AISC "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC "Allowable Stress Design Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Architecturally Exposed Structural Steel".
4. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
5. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
6. ASTM A6 “General Requirements for Delivery of Rolled Steel Plates, Shapes, sheet Piling and Bars for Structural Use”.
7. Hot-dip galvanizing fabrication practices: Conform to the requirements of ASTM A143, A384 and A385 unless otherwise specified.
8. SSPC “Steel Structures Painting Manual”.

B. Designer/Engineer Qualifications: Connections not specifically detailed on the Contract Drawings are to be designed under the direct supervision of a New Jersey Registered Professional Engineer specializing in structural steel engineering.

C. Installer Qualifications: Classified in Structural Steel trade by the NJ Department of the Treasury, Division of Property Management and Construction.

D. Fabricator Qualifications: Company specializing in structural steel fabrication.

E. Galvanizing Applicator: Company specializing in hot-dip galvanizing after fabrication and approved by the manufacturer and/or fabricator.

F. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure". If recertification of welders is required during extent of this Project, retesting will be the Contrctor’s responsibility.

1.7 CONNECTION DESIGN AND MEMBER DETAILING

A. Member Detailing and Design of Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site without causing delay in the work.
   1. Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

B. Design connections as “Framed Beam Connections: in accordance with Part 4 of the AISC Manual, except as otherwise indicated.
   1. For noncomposite beams, reaction shall be end reaction on member, as defined in the AISC “Uniform Loaded Beam Tables”, or reaction shown on the Drawings, whichever is greater.
   2. For composite beams, use reaction shown on the Drawings.
   3. Single sided connections for spandrel beams are not acceptable.
   4. Bolts: A325 or A490. Connections may be designed using Type N Bolts, except at hanger connections and where other slip-critical connections (designated as SC) are indicated on the Drawings; design slip-critical connections using Type SC bolts.

C. Shop and Field Connections:
   1. Shop connections are to be welded unless indicated otherwise on the Drawings.
   2. Bolt field connections with high-strength bolts except where welded connections or other connections are indicated.
   3. Bolts: 3/4 inch diameter minimum
   4. Fillet welds: 1/4 inch minimum, unless otherwise noted

D. Except where seated connections are shown or required, frame beams and girders into columns. Reinforce beam webs at seated connections for stability and to prevent buckling.

E. Moment Connections:
   1. Where a moment connection is noted on plans, provide a moment connecton at the beam to column connection or supporting beam to beam framing connection.
   2. Unless noted otherwise or as a wind moment connection, the moment connection is to develop the full strength of the beam in bending. Use plates, top and bottom of the beam, to accomplish development.
   3. Cantilevers require full moment connections “thru” column or supporting beam, unless beam rides over supporting member or column.
   4. For moment connections “thru” columns, add beam stiffener plates minimum 3/8 inches thick. When the beam is parallel to the column web, the stiffener plates are to be equal to the flange thickness of the column and installed in line with the column flanges. When the beam is perpendicular to the column web, the stiffener plates are to be equal to the web thickness and installed in line with the column web. In addition, when beam is perpendicular to the column web, install column cap plate stiffeners equal to the column web thickness. The cap plate stiffeners are to be installed on both sides of the column web in line with the beam web.
   5. Where a moment connection is indicated at a beam to beam connection, the supporting beam is to be continuous and a full moment and shear connection provided for the terminated beam.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.
   1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry or attached to other construction, in ample time to not-delay work.
C. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
D. Do not store materials on the structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.9 TEMPORARY BRACING

A. The steel erector/contractor is responsible for the design, strength, adequacy, safety and means and methods of construction of shoring and temporary bracing of Structural Steel Work at all stages of erection, until such time that permanent members and construction are in place and final connections are completed.

1.10 PROJECT CONDITIONS

A. Field verify all existing measurements and elevations prior to beginning fabrication process. Architect will not review or take responsibility for any existing dimensions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness in accordance with the AISC “Specifications for Architecturally Exposed Structural Steel”. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
B. Structural Steel Shapes, Plates and Bars: ASTM A 36

C. Structural Steel Tubing:
   Cold-Formed: ASTM A 500, Grade B
   Hot-Formed: ASTM A501

D. Pipe: ASTM A53, Type E or S, Grade B
E. Carbon-Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel
F. High-Strength Steel Castings: ASTM A 148, Grade 80-50
G. Headed Stud-Type Shear Connectors: ASTM A108, Grade 1015 through 1020, forged steel, headed-stud type, uncoated cold-finished carbon steel, AWS D1.1, Type B
H. Bolts, Nuts, and Washers:
   1. Unheaded Rods: ASTM A 36 (ASTM A 36M)
   2. Unheaded Rods: ASTM A 572, Grade 50 (ASTM A 572M, Grade 345)
   3. Anchor bolts: ASTM A307, nonheaded type unless otherwise indicated
   4. Standard threaded fasteners:
      a. Plain washers: ANSI B27.2, Type A
      b. Beveled washers: ANSI B27.4
      c. Nuts and bolts: ASTM A307, Grade A

   5. High-Strength Threaded Fasteners: Quenched and tempered medium-carbon steel. modify if a490 bolts are required.
      a. Bolts: Heavy hexagon ASTM A325
      b. Nuts: Heavy hexagon ASTM A563, Grade DH
      c. Washers: Hardened ASTM F436, beveled at channel flanges

   6. Direct Tension Indicator Fasteners: Load indicator washers to conform to ASTM F959, or tension control bolts may be used.

I. Electrodes for Welding: Comply with AWS Code.
   1. Welding Materials: AWS D1.1; type required for materials being welded.

J. Structural Steel Primer Paint: SSPC - Paint 13
   1. Acceptable products:
      a. Glidden 5205 Glid-Guard Red Alkyd Metal Primer
      b. Southern Coatings Enviro-Guard Heavy Duty Primer 1-2900
      c. Con-Lux Ferrox 25
      d. MAB Rust-O-Lastic Shop Primer Red Alkyd 24-R-181 or Rust-Oleum 7669
      e. Or Approved Equal

   2. Where faying surfaces of slip-critical joints are permitted by Architect to be painted, provide Class A paint (providing a minimum slip coefficient of 0.33) in accordance with Test Method to Determine Slip Coefficient for Coatings used in Bolted Joints, in Appendix A of the RCSC Specification for Structural Joints. Manufacturer's certification shall include a certified copy of the test report.

K. High Performance Primer Paint: Polyurethane coating system equivalent to Series 66 Hi-Build Epoxoline by Tnemec Company, Inc.
L. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds and repair painting galvanized steel, complying with Military Specifications DOD-P-21035 (Ships) or SSPC-Paint-20.
M. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
N. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

1. Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives.
2. Acceptable products:
   a. Euco N.S. by Euclid Chemical Co.
   b. Five Star Grout by Five Star Grout Corp.
   c. Masterflow 713 by Master Builders
   d. or Approved Equal

2.2 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final approved shop drawings. Provide camber in structural members where indicated.

B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

C. Where finishing is required, complete structural steel assemblies, including welding of units, before starting shop-priming of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs and other defects.

D. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
   1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
   2. Comploy with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

E. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded.

F. Finishing: Accurately mill ends of columns and other members trnasmitting loads in bearing.

G. Shear Connectors: Perpare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.

H. Connections:
   1. Welded Connections: Comply with AWS D1.1 Code for procedures, appearance and quality of welds and methods used in correcting welding work.
      a. Join members with continuous welds, except where bolted connections are indicated.
      b. Stress relieve welded assemblies by heat treatment.
      c. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.
      d. Grind welds smooth.

   2. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.
   3. Bolted connections: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" (RCRBSJ).
      a. Shear-bearing connections: Bolts in connections not within slip-critical category, nor subject to tension loads, nor required to be fully tensioned bearing type connections shall be installed in properly aligned holes, tightened to snug-tight condition. Snug-tight condition is defined as tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or full effort of a man using an ordinary spud wrench.
      b. Slip-critical Connections: Connections subject to direct tension, and fully pretensioned bearing connections, fasteners, together with washers of size and quality specified, shall be installed in

properly aligned holes and tightened by one of methods described in Subsections 8(d) (1) through 8(d) (4), of referenced standard, to at least minimum tension specified when all fasteners are tight.

I. Bolt field connections, except where welded connections or other connections are indicated.
   1. Provide high-strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.

J. Holes for Bolted Connections and Other Work:
   1. 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.
   2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning.
   3. Drill holes in bearing plates.
   4. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.

K. Masonry Anchors:
   1. Provide anchors welded to steel columns and beams for support of masonry abutting and masonry adjacent to structural steel.
   2. Space anchors 24 inches on center vertically for columns and 32 inches on center horizontally for beams.
   3. Acceptable product: No. 315 by Heckmann Building Products, or equal by Hohmann and Barnard, Simpson, or approved equal.

2.3 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.
B. Fabricate structural steel in accordance with Class I, II, or III guidelines as described in AGA's Recommended Details for Galvanized Structures.
C. Use fabrication practices for products in accordance with applicable portions of ASTM A143, A384 and A385, except as specified herein. Avoid fabrication techniques which could cause distortion or embrittlement of steel.
D. Consult Architect regarding potential warpage problems or potential handling problems during the galvanizing process which may require modification of design before fabrication proceeds.
E. Remove welding slag and burrs prior to delivery for galvanizing.
F. Provide holes and/or lifting lugs to facilitate handling during the galvanizing process that are suitable to Architect and fabricator.
G. Remove, by blast cleaning or other methods, surface contaminants and coatings which would not be removable by normal chemical cleaning process in galvanizing operation.
H. Application of Coating:
   1. All exterior exposed structural steel shall be galvanized including all exterior wall lintels.
   2. Steel members, fabrications and assemblies: Comply with ASTM A123.
   3. Bolts, nuts and washers and iron and steel hardware components: Comply with ASTM A153.
   4. Coating weight: Conform with paragraph 5.1 or ASTM A123 or Table 1 of ASTM A153, as appropriate.
   5. Provide post-galvanizing treatments as recommended by AGA for conditions applicable to Work.

2.4 SHOP FINISH

A. Shop Painting:

   1. General: Shop paint structural prime steel, except those members or portions of members as otherwise specified the following:

a. Do not paint surfaces which are to be field welded or high-strength bolted in slip-critical type connections.
b. Do not paint members or portions of members which are shown to be embedded in concrete.
c. Do not paint top flange surfaces of beams to receive composite metal shear studs.
d. Galvanize surfaces.

2. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
   a. SP-1 "Solvent Cleaning"
   b. SP-3 "Power Tool Cleaning"

3. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with Manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.
   a. Apply 2 coats of paint to surfaces which are inaccessible after assembly and erection. Change color of second coat to distinguish it from first.
   b. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only.

B. Shop Painting Galvanized Metal with High Performance Paint:
1. Clean by SSPC-SP1 "Solvent Cleaning", followed by SSPC-SP2 "Hand Tool Cleaning" or SSPC-SP3 "Power Tool Cleaning" to remove oil and grease, soil, cement spatter, and other surface dirt.
2. Cleaned surfaces are to be rinsed thoroughly, and allowed to dry completely before coating.
3. Apply prime coat as soon as possible after cleaning. Provide smooth, uniform dry film thickness of 4.0 to 6.0 mils.

2.5 SHOP QUALITY CONTROL

A. Contractor's Responsibilities:
1. Visual inspection:
   a. Perform visual inspection of all welds.
   b. Inspect bolted connections in accordance with AISC Specifications for “Structural Joints Using ASTM A325 or A490 Bolts”.

2. Repair all discrepancies in dimensional tolerances of connection assembly and defects requiring corrective procedures.

B. Testing and Inspection Agency Responsibilities:
1. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:
   a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
   b. Perform visual inspection of all welds.
   c. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency’s option.
      (1) Liquid Penetrant Inspection: ASTM E165
      (2) Magnetic Particle Inspection: ASTM E709; performed on roof pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      (3) Radiographic Inspection: ASTM E94 and ASTM E142; minimum quality level “2-2T”.
      (4) Ultrasonic Inspection: ASTM E164

2. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and adjoining construction, and conditions under which Work is to be installed. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Surveys: Employ a registered professional engineer or land surveyor for accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies in writing to Architect within 48 hours. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.

B. Temporary Shoring and Bracing:
   2. Provide temporary supports required for stability of the structure and for resistance to wind and seismic forces until these elements are complete and are capable of providing this support.
   3. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads.
   4. Do not remove temporary members and connections until permanent members are in place, final connections are made and concrete slabs are cured.
   5. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

C. Setting Base and Leveling/Bearing Plates:
   1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.
   2. Clean bottom surface of base and bearing plates.
   3. Set loose and attached base plates and bearing plates for structural members on wedges, shims, or setting nuts, or other adjusting devices.
   4. Tighten anchor bolts after supported members are positioned and plumbed.
   5. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or leveling/bearing plate prior to packing with grout.
   6. Pack non-shrink grout solidly between bearing surfaces and bases or plates so that no voids remain. Comply with grout manufacturer's instructions.

3.3 ERECTION

A. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated.
2. Align and adjust various members forming part of complete frame or structure before permanently fastening.
3. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.
4. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
5. Level and plumb individual members of structure within specified AISC tolerances.
6. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
7. Splice members only where indicated and accepted on final approved shop drawings.
8. Complete field connections prior to loading member.
9. On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
10. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
11. Gas Cutting: Do not use gas thermal cutting torches in field during erection for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to the Architect. Finish gas-cut sections equal to a sheared appearance when permitted.
12. Direct Tension Indicator: Bolts shall be installed in all holes of the connection and brought to snug tight condition. All fasteners shall then be tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners prior to final twist-off or yielding of the control or indicator element of the individual devices. Proper tensioning of the bolts may require more than a single cycle of systematic tightening.

B. Comply with AISC Specifications for bearing, adequacy of temporary connections, alighment and removal of paint on surfaces adjacent to field welds.

C. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
   1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

D. Touch-Up Galvanizing:
   1. Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.4 FIELD QUALITY CONTROL

A. The Contractor will engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

B. Testing agency shall conduct and interpret tests and state in each report whether test specimens and Work evaluated comply with requirements, and specifically state any deviations therefrom.
   1. Reports:
      a. Provide daily written reports.
      b. Describe areas inspected.
      c. Note problems.
      d. Describe compliance with Contract Documents.
      e. Include tests conducted and results.

C. Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.

D. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.

E. Structural steel erection shall be inspected while the Work is in progress.
   1. Field Bolted Connections: General
      a. The torque of 10 percent of the bolts, but not less than 2 bolts, selected at random in each connection are to be tested with an inspecting wrench calibrated with the job torque.
      b. Load indicator washers delivered for use in a specific application are to be tested at the job site to demonstrate that they do, in fact, provide a proper indication of bolt tension, and that they are properly used by the bolting crews.
      c. Bolts together with the load indicator washer plus any other washers required by Specification should be installed in all holes of the connection and the bolts tightened to approximately one-half the specified tension. Only after the initial tightening operation should the bolts be fully tensioned in a systematic manner.
      d. The use of load indicator washers are to be observed by the inspection agency at the job site and the devices and the installation procedure routinely monitored during the work in progress to assure that the specified procedure is followed.

   2. Slip-critical or direct tensioning connections:
      a. Observe calibration procedures for specific fastener tightening method employed;
      b. Monitor installation of bolts to determine that plies of connected material have been drawn together;
      c. Assure that accepted tightening procedure is subsequently followed to achieve minimum fastener pretension.

   3. Connections which are not slip-critical or in direct tension:
      a. Assure that plies of connected elements have been brought into snug contact (usually attained by a few impacts of an impact wrench or full effort of a man using an ordinary spud wrench);
      b. Assure that washers are used in outer plies of slotted holes or as otherwise required.

   4. Visually inspect field welds for conformance with AWS criteria and the Drawings, except full penetration welds done in the field shall be inspected by ultrasonic testing.
   5. Visually inspect composite steel stud welds and perform bend tests in accordance with AWS D1.1, Section 7.8.
   6. Inspect metal deck installation, fasteners, openings, etc., for conformance with approved Shop Drawings.

END OF SECTION

SECTION 05 31 00
STEEEL ROOF DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes the supply and installation of new metal roof deck

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.
B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
C. Product Certificates: For each type of steel deck, signed by product manufacturer.
D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Screw fasteners.

E. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Member in good standing of Steel Deck Institute (SDI).
   2. ISO 9001:2000 accredited by ANSI Registrar Accreditation Board (ANSI-RAB).

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
C. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Steel Deck Institute - "Manual of Construction with Steel Deck" (SDI - MOC2).
B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
C. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 COORDINATION

A. Coordinate installation with roofing installation specified in Section 07 55 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Steel Deck:
      a. ASC Profiles, Inc.
      b. Consolidated Systems, Inc.
      c. DACS, Inc.
      d. D-Mac Industries Inc.
      e. Epic Metals Corporation
      f. Marlyn Steel Decks, Inc.
      g. Nucor Corp.; Vulcraft Division
      h. Roof Deck, Inc.
      i. United Steel Deck, Inc.
      j. Verco Manufacturing Co.
      k. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation
      l. Or approved equal

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, with or without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, minimum, ASTM A 924/A 924M-99 G90 zinc coating in accordance.
   2. Profile Depth: As shown on drawings
   3. Span Condition: Simple span
   4. Side Laps: Nestable

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0358-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
G. Coordinate reinforcing requirements of openings in first paragraph below with other Division 5 Sections.
H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
I. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
J. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. This Article includes installation requirements for classes of roof deck and form deck used in roof applications. Revise paragraph below and insert requirements if mechanical fastening to supports is permitted.
B. Fasten roof-deck panels to steel supporting members with specified fasteners
C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:
    1. End Joints: Lapped 2 inches minimum.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION

SECTION 05 50 10
METAL FABRICATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply, fabrication, and installation of concrete filled steel bollards

1.3 RELATED WORK

A. Concrete for setting bollards is specified in Section 03 30 00.

1.4 REFERENCES

A. The publications listed below form a part of these Specifications to the extent applicable:
   1. AISC "Code of Standard Practice for Steel Buildings and Bridges."
   2. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: “This approval constitutes the owner’s acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings”.
   3. ANSI/AWS D1.1, "Structural Welding Code - Steel."
   4. ASTM A 6 “General requirements for delivery of rolled steel plates, shapes, sheet piling and bars for structural use”.

1.5 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.6 SUBMITTALS

A. Prepare and submit shop drawings of all work of this Section to the Architect for approval. Coordinate work with respective trade.
B. Shop drawings shall show finishes, fastenings and relation to surrounding materials and shall indicate the kind of material size, detail of pieces worked out in due reference of their positions, framing, method of securing same together and the proper execution of the work in connection with other trades.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel Pipe Bollards: ASTM A 53, schedule 120. Exterior bollards are to be galvanized. Fill bollards with concrete flush at top. Do not paint bollards. Install pipe bollard plastic cover.
B. Pipe Bollard Plastic Covers: Exterior shell cover of low density polyethylene are to be 1/4 inch nominal wall thickness with ultraviolet and anti-static additives and a dome top. Install over steel pipe posts.

2.2 PAINT

A. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, complying with the Military Specifications MIL-P-21035 (Ships).

2.3 GALVANIZATION

A. Galvanizing: Provide a zinc coating for all items scheduled or specified to be galvanized, as follows:
   1. ASTM A 153 G90 for galvanizing iron and steel hardware.
   2. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8" thick and heavier.
   3. ASTM A 386 G 90 for galvanizing assembled steel products.

B. Galvanization Schedule:
   1. Bollards

C. All fabrications shall be hot dipped galvanized after fabrication.

2.4 FABRICATION, GENERAL

A. Workmanship: Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
B. Forming: Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
C. Welding: Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
D. Forming Corners: Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (countersunk) screws or bolts.
E. Anchorage: Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Bollards: Set bollards plumb at location shown on drawings. Place concrete footing using 4,000 psi concrete.

END OF SECTION

SECTION 05 51 00
METAL PAN STAIRS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply, construction, and installation of custom metal pan stairs.

1.3 RELATED WORK

A. The following similar work is specified under other Sections:
   1. Section 05 52 13 Metal Railings
   2. Section 03 30 00 Cast-in-Place Concrete
   3. Section 09 65 19 Laminate Flooring
   4. Section 09 90 00 Painting and Coatings

1.4 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A36 Standard Specification for Carbon Structural Steel
   2. ASTM A786 Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel
   3. ASTM A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability Solution Hardened, and Bake Hardenable.
   4. ASTM A1011 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.

B. American Welding Society (AWS):
   1. AWS D1.1 Structural Welding Code - Steel
   2. AWS D1.3 Structural Welding Code - Sheet Steel
   3. American National Standards Institute (ANSI)
   4. ANSI A117.1 Accessible and Usable Buildings and Facilities Standards

C. Steel Structures Painting council (SSPC):
   1. SSPC Paint 15 - Type 1, Red Oxide
   2. SSPC Paint 20 - Type 1 Inorganic Zinc Rich

D. Reference Codes:
   1. International Building Code, New Jersey Edition 2021
   2. ICC/ANSI Code A117.1-2017
   3. Americans with Disabilities Act Accessibility Guidelines

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.

1.6 SUBMITTALS

A. General: Submit listed submittals in accordance with Submittal Procedures.
B. Product Data: Submit manufacturer's product data.
C. Complete Shop Drawings
D. Manufacturer's installation instructions.
E. Shop Drawings: Indicate information on shop drawings as follows:
   1. Stair plans, elevations, details, methods of installation and anchoring, members, sizes and thickness, anchorage locations and accessory items.
   2. Furnish setting diagrams for anchorage installation as required.
   3. Include calculations stamped by a structural engineer registered in the jurisdiction in which the project is located. Drawings are diagrammatic and do not show all connections. The stair engineering shall include all components and anchorages necessary to secure the stair system to the building structure.

1.7 DELIVERY, STORAGE & HANDLING

A. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
B. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

PART 2 – PRODUCTS

2.1 DESIGN CRITERIA

A. Structural Performance of Stairs: Stairs shall withstand the following structural loads without exceeding the allowable:
   1. Design working stress of materials, including anchors and connections. Apply each load to produce the maximum stress in each component:
      a. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 psf and concentrated load of 300 lbf applied on an area of 4 square inches (2581 square mm). Concentrated and uniform loads need not be assumed to act concurrently.
      b. Stair Framing: Capable of withstanding stresses resulting from loads specified, in addition to stresses resulting from railing system loads.
      c. Limit Deflection of Treads, Platforms and Framing Members: To L/240.

B. Stair System:
   1. Manufacturer's standard prefabricated, pre-engineered straight run stair and landing system, consisting of hot rolled steel sheet stringers, risers, treads, landings, fasteners/supports and railings.
      a. Stringers:
         1) Steel plate or channel with side mounted prefabricated railings.
         2) Minimum thickness or gage as determined by structural design calculations, structural grade steel plate or channel.

   2. Risers: Closed riser, minimum 14 gage hot rolled mild steel sheet, sloped maximum 1 1/2 inches and conforming to Americans with Disabilities Act (ADA) nosing requirements.
   3. Treads: Manufacturer's standard concrete pan system, field poured. Tread pans to be minimum of 14 gage, or as determined by design calculations. Pan depth 1 1/2 inches. Exposed welds from the bottom side of flight assemblies will not be allowed. All welds to be from topside of tread pans as recommended by manufacturer.
   4. Mid Landings: Minimum of 12 gage hot-rolled mild steel sheets, formed for a minimum 2 1/2 inches concrete fill, with 11 gage channel supports and bracing welded to perimeter frame at 12 inches on center.

5. Fasteners and Supports: Sized by the manufacturer to meet structural design criteria. If hanger rod connections are applicable to any of the landing connections, they shall be a minimum of 5/8 inch diameter steel rod, with actual size based on stair load.
   a. Fabrication:
      1) Use preformed or prefabricated bends.
      2) Butt weld tee and cross intersections in tubing. Cope and weld intersections in pipe. Miter elbows.
      3) Mechanically fasten internal sleeves and fittings.
      4) Provide minimum 12 gage welded steel plate closures or hemispherical closure fittings on all exposed rail ends.

6. Landings: Refer to Finish Schedule on Drawings.

C. Materials:
   1. Steel Shapes and Plates: To ASTM A36
   2. Steel Pipe: To ASTM A53 Type E or S, Grade B
   3. Steel Tubing:
      a. Structural Use: To ASTM A500, Grade B or C
      b. Non-Structural Use: To ASTM A513, hot rolled or coiled rolled (mill option)

   4. Steel Sheet:
      a. Structural Use: To ASTM A1011 (hot rolled)
      b. Non-Structural Use: To ASTM A786, ASTM A1008

   5. Fasteners: As recommended by manufacturer.
   6. Welding Rods: In accordance with AWS code and AWS filler metal specifications for material being welded.
   7. Primer: HAPS-free, solvent-based, rust inhibitive primer containing less than 3.5 lb/gal Volatile Organic Compounds (VOC) and compatible with conventional alkyds topcoats.

D. Fabrication:
   1. Use same material and finish as parts being joined. Use stainless steel between dissimilar metals and non-corrosive fasteners at exterior connections or joints.
   2. Provide fasteners of sufficient strength to support connected members and loads, and to develop full strength of parts fastened or connected.
   3. Construct stairs with all components necessary for support and anchorage, and for a complete installation.

E. Finishes
   1. Stair Components: Completely remove oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter from steel surface in accordance with SSPC SP3.
   2. Shop Primer: Immediately after fabrication and cleaning, spray apply primer to dry film thickness recommended by the primer manufacturer, but not less than 2.0 mil thickness. Apply one coat High Solids Red Oxide Anticorrosive primer meeting SSPC-15 Paint.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to metal stair and railing installation.
   1. Inform Architect of unacceptable conditions immediately upon discovery.

2. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Architect.

3.2 INSTALLATION

A. Coordinate metal stair work with work of other trades for proper time and sequence to avoid construction delays.
B. Install stairs and landings in accordance with manufacturer's instructions. Install square, plumb, straight and true to line and level, with neatly fitted joints and intersections.
   1. Do not cut or alter structural components without written authorization.
   2. Field welding and joining shall conform to AWS D1.1 and AWS D1.3.
   3. Grind all exposed welds smooth and touch-up shop-primed areas with same primer as used by Manufacturer

3.3 ADJUSTING

A. Adjust components and systems for correct function and operation in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 05 52 13
METAL RAILINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the following:
   1. Fabrication and installation of painted galvanized steel pipe rails.

1.3 RELATED WORK

A. The following similar work is specified under other Sections:
   1. Section 09 90 00 - Painting and Coatings
   2. Section 05 12 00 - Structural Steel

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 53 - Specification for Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe
   2. ASTM 123 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   3. ASTM E 894 - Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings
   4. ASTM E 935 - Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings
   5. ASTM E 985 - Permanent Metal Railing Systems and Rails for Buildings

B. Steel Structures Painting council (SSPC):
   1. SSPC Paint 15 - Type 1, Red Oxide
   2. SSPC Paint 20 - Type 1 Inorganic Zinc Rich

1.5 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on testing performed in accordance with ASTM E 894 and E 935.

1.6 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance of Handrails and Railing Systems: Engineer, fabricate and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

B. Handrails not serving as top rails; capable of withstanding the following loads applied as indicated:
   1. Concentrated load of 200 pounds applied at any point and in any direction.
   2. Uniform load of 50 pounds per linear foot applied horizontally and concurrently with a uniform load of 100 pounds per linear foot applied vertically downward.
   3. Concentrated and uniform loads shall not be applied simultaneously.
   4. Railing assembly, wall rails, and attachments to comply with local code requirements and to resist minimum 100 pound lateral force at any point without damage or permanent set.

1.7 SUBMITTALS

A. Procedures for submittals.
   1. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
   2. Assurance/Control Submittals: Certificates: Manufacturer's certificate that Products meet or exceed specified requirements.

PART 2 – PRODUCTS

2.1 STEEL PIPE RAIL MATERIALS

A. Pipe: ASTM A 53, Grade B Schedule 80
B. Rails and Posts: Steel pipe; with welded joints, of sizes and shapes as indicated on Drawings
C. Fittings: Elbows, T-shapes, wall brackets, escutcheons; machined steel
D. Mounting on Concrete Floor: Steel sleeves, sized to receive railing post with 1/4 inch clearance
E. Mounting on Steel Channels: Welded as indicated on the Drawings
F. Splice Connectors: Steel threaded collars

2.2 ACCESSORIES

A. Brackets, Flanges, and Fittings: Same material as primary railing components.
B. Anchors and Inserts: Galvanized or stainless steel, expansion type; capable of withstanding structural design loads specified.
C. Screws: Galvanized or stainless steel, 18-8 alloy, non-magnetic
D. Balcony Separators: Manufacturer's aluminum fasteners designed to hold separation panels between 1/4 inch and 5/16 inch thick
E. Grout: Non-shrink Portland cement-based hydraulic grout, mixed and applied per manufacturer's instructions; no gypsum grout allowed.

2.3 STEEL PIPE RAIL FABRICATION

A. Fit and shop assemble sections in largest practical sizes, for delivery to site and installation.
B. Supply components required for secure anchorage of handrails and railings.
C. Fully weld joints. Grind exposed welds smooth and flush with adjacent surfaces.
D. Wake exposed joint butt tight, flush, and hairline.
E. Accurately form components required for anchorage of railings to each other and to building structure.
F. Prime railings which will be exposed.

2.4 FINISH (PAINTED PIPE RAIL)

A. Galvanizing: ASTM A123; provide minimum 2.0 ounces per square foot.
B. Touch-Up Primer for Galvanized Surfaces: SSPC 20 Type I Inorganic zinc rich.
C. Field paint as specified in Section 09 90 00.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work. Verify field dimensions prior to shop fabrication.
B. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Furnish items required to be cast into concrete, embedded in masonry, placed in partitions with setting templates, to appropriate Sections.
B. For wall mounted railings, coordinate with General Contractor to assure adequate substrate (blocking) is installed in the appropriate locations to support the railing and accept fasteners.

3.3 INSTALLATION

A. Install in accordance with manufacturer's published instructions.
    1. Install components plumb and level, accurately fitted, free from distortion or defects.
    2. Anchor railings to structure with anchors in conformance with ASTM E 985.
    3. Field weld anchors as indicated on Drawings. Touch-up welds with primer. Grind welds smooth.
    4. Insert railing posts in sleeves and pack sleeves with non-shrink grout.

3.4 CONSTRUCTION

A. Site Tolerances:
    1. Maximum Variation From Plumb: 1/4 inch
    2. Maximum Offset From True Alignment: 1/4 inch
    3. Maximum Out-of-Position: 1/4 inch

3.5 FIELD QUALITY CONTROL

A. Inspect railings and handrail installation and attachment to structure.
B. Inspect paint finish applied to surfaces.

END OF SECTION

SECTION 06 05 73
WOOD PRESERVATIVE TREATMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Requirements for wood preservative treatment for dimensional lumber.

1.3 RELATED SECTIONS

A. Section 06 10 00 – Rough Carpentry
B. Section 06 11 41 – Wood Nailers, Cants, and Blocking

1.4 REFERENCES

A. American Wood Protection Association (AWPA):
   1. Standard U1, Wood treated with preservative system
   2. Standard T1, Use Category System
   3. Standard A, Analytical
   4. Standard M, Quality Control

B. National Institute of Standards and Technology (NIST):
   1. PS 1, U.S. Product Standard for Construction and Industrial Plywood
   2. PS 20, American Softwood Lumber Standard

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Provide waterproof covers for preservative treated wood during shipment.
B. Storage and Protection: Store preservative treated wood off the ground and protected from the weather.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Lumber for preservative treatment must conform to the following specifications.
B. Lumber: In accordance with NIST PS 20 and as follows:
   1. Grade: No. 2 Dense or better
   2. Species: Southern pine.
   3. Surfacing: S4S

2.2 PRESERVATIVE TREATMENT

A. UC1 - INTERIOR/DRY: Wood and wood-based materials used in interior construction not in contact with the ground or foundations. Such products are protected from weather and interior sources of water such as leaking plumbing, condensate, pools and spas. Examples are interior furniture, construction furnishings, and millwork.
B. UC2 - INTERIOR/DAMP: Wood and wood-based materials used for interior construction that are not in contact with ground, but may be subject to dampness. These products are continuously protected from the

weather but may be exposed to occasional sources of moisture. Examples are interior beams, timbers, flooring, framing, millwork, and sill plates.

C. UC3A – EXTERIOR/PROTECTED: Wood and wood-based materials used for exterior construction that are not in contact with the ground, but may be exposed to the full effect of the weather. These members are oriented in vertically that allow water to quickly drain from the surface. Examples may include millwork, siding and trim.

D. UC3B – EXTERIOR/UNPROTECTED: Wood and wood-based materials used for exterior construction that are exposed to all weather cycles, but with sufficient air circulation so wood can readily dry. Excludes above ground applications with ground contact type hazards. Examples may include decking, railings, joists and beams for freshwater docks, fence pickets, and uncoated millwork.

E. UC4A – EXTERIOR/GROUND CONTACT: Wood and wood-based materials that are in contact with the ground, fresh water, or other situations favorable to deterioration, above ground but are difficult to maintain, repair, or replace, or are above ground and are subject to hazards comparable to ground contact.

F. UC4B/C – EXTERIOR/GROUND CONTACT SEVERE: Wood and wood-based materials typically in contact with the ground in severe environments with high potential for deterioration. Typical applications may include areas where there is considerable exposure to moisture such as rivers or lakes and may include water pilings, and foundation pilings.

2.3 SOURCE QUALITY CONTROL

A. Inspection:
   1. Untreated Material:
      a. Lumber: Provide lumber that has been inspected and graded by an ALSC recognized grading agency.

   2. Treated Material: Provide treated material that bears the Natural Select trademark and the quality mark of an ALSC-recognized agency which maintains supervision, testing, and inspection of the quality of the product. Quality marks shall be affixed to each piece and include the following:
      a. Identification of the inspection agency
      b. Identification of the standard to which the material was treated
      c. Identification of the treating facility
      d. Identification of the preservative and retention
      e. Identification of the end use for which the product is suitable

2.4 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages: Provide size, type material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails. Provide stainless steel fasteners and anchorages or a hot-dip galvanized coating meeting ASTM A 153, ASTM Standard A653 (Class G-185)

PART 3 – EXECUTION

3.1 INSTALLATION

A. Surface Treatment of Field Cuts: Treat field cuts on members that provide structural support to a permanent structure in accordance with AWPA Standard M4.

TABLE 1

SCHEDULE OF USE

Member	Treatment
Miscellaneous Members in Contact with Masonry or Concrete	UC2
Roofing members	UC3A

END OF SECTION

SECTION 06 09 00
METAL CONNECTORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Pre-engineered metal connectors used to support a wood or composite wood member(s) from a wood, or composite wood supporting member(s).

1.3 RELATED SECTIONS

A. Section 06 10 00 – Rough Carpentry – Wood supported by fastenings or providing support or anchorage.

1.4 REFERENCES

A. ASTM A36 – Carbon Structural Steel
B. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
C. ASTM A193-B7 – Alloy Steel and Stainless-Steel Bolting Materials for High Temperature
D. Service
E. ASTM A307 – Carbon Steel Bolts and Studs
F. ASTM A1011 – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
G. ASTM F1667 – Driven Fasteners: Nails, Spikes, and Staples
H. ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood
I. ICBO AC13 – Acceptance Criteria for Joist Hangers and Similar Devices
J. ICBO AC95 – Acceptance Criteria to Determine Bending Yield Moment for Nails
K. ICBO AC120 – Acceptance Criteria for Wood Screws
L. AISI – Cold-Formed Steel Specification
M. NDS – National Design Specification
N. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
O. ASTM A625 – Tin Mill Products, Black Plate, Single Reduced
P. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
Q. ASTM A706 – Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
R. ASTM A924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.5 STORAGE AND HANDLING

A. Deliver products to job site in manufacturer's, or distributor's, packaging undamaged, complete with installation instructions.
B. Protect and handle materials in accordance with manufacturers' recommendations to prevent damage or deterioration.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Simpson Strong-Tie Co., Inc. is the basis for design for this Project. Other manufacturers including TECO, USP, or approved equal, having compatible products may be utilized subject to their product meeting the design requirements and loadings.

2.2 MATERIALS

A. Steel: Sheet steel shall comply with ASTM A625, ASTM A653, ASTM A1011. Fasteners shall comply with ASTM F1667, SAE C1022 (SDS Screws)
B. Stainless Steel Sheet: ASTM A167
C. Finishes: Hot-dipped galvanized or electro-plated galvanized: G185 (ZMAX)

2.3 FABRICATION

A. Shop assembly to occur per the manufacturer's approved production drawings.
B. Fabrication tolerances per manufacturer
C. Fabrication requiring welding shall be performed in accordance with the current American Welding Society's standards.
D. The manufacturer's identification shall be stamped into the metal part and/or a label may be attached to the part with adhesive.

2.4 TESTING

A. Allowable loads published in manufacturer's catalog to be determined using the minimum load from static and/or cyclic analysis and one or more of the following test methods:
   1. Static load tests in wood assemblies
   2. Static load tests in steel jigs
   3. Static load tests of products embedded in concrete or masonry
   4. Cyclic or static load tests in wood assemblies (Anchor Tiedown System)

B. Testing to determine allowable loads shall be performed as per ICBO Acceptance Criteria 13 (AC13) and/or ASTM D1761.
C. Allowable loads for hangers are determined by a static load test resulting in not more than a 1/8" deflection of the joist relative to the header, or the lowest test ultimate load divided by 3, or the fastener allowable load as determined by the NDS, whichever is lower.
D. Testing shall be conducted under the supervision of an independent laboratory.
E. Manufacturer to provide code testing data on all products that have been code tested upon request.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Unless otherwise noted in the manufacturer's catalog, allowable loads are for Douglas Fir-Larch under continuously dry conditions. Allowable loads for other species or conditions must be adjusted according to the code. See manufacturer's catalog for additional notes and requirements.
B. Built-up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
C. Verify that the dimensions of the supporting member are sufficient to receive the specified fasteners.

3.2 INSTALLATION

A. Unless otherwise noted in the manufacturer's catalog, bolts and nails shall not be combined.
B. All nails shall be common unless otherwise noted in the manufacturer's catalog or substituted, by the engineer of record, with a reduction taken.
C. Unless otherwise noted in the manufacturer's catalog, bending steel in the field may cause fractures at the bend line. Fractured steel will not carry load and must be replaced. When bending is allowed or required in the catalog, the connector shall be allowed one cycle bend, one time only.
D. Galvanized connectors should not be placed in contact with treated wood unless the treated wood is adequately verified to be suitable for such contact. Some wood treatments may accelerate metal deterioration. See wood material supplier for specific recommendations.
E. A fastener that splits the wood will not take the design load. Evaluate splits to determine if the connection will perform as required. Dry wood may split more easily and should be evaluated as required. If wood tends to split, consider pre-boring holes with diameters not exceeding 0.75 of the nail diameter.
F. Wood shrinkage shall be taken into account when designing and installing connections.
G. Built-up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
H. Top flange hangers may cause unevenness. Possible remedies should be evaluated by a professional and include using a face mount hanger, routing the beam, or cutting the subfloor to accommodate the top flange thickness.
I. Do not overload by exceeding the manufacturer's catalog allowable load values.
J. Unless otherwise noted in the manufacturer's catalog, fill all fastener holes with fastener types as specified in the manufacturer's catalog.
K. All specified fasteners must be installed according to the instructions in the manufacturer's catalog.
L. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter.
M. Install all specified fasteners before loading the connection.
N. Use proper safety equipment.
O. Welding shall be in accordance with the American Welding Society (AWS) standards.
P. Welding galvanized steel may produce harmful fumes, follow proper welding procedures and safety precautions.
Q. Nail tools with hole-location mechanisms may be used to install connectors, provided the correct quantity and type of nails are properly installed in the nail holes.
R. Joist shall bear completely on the connector seat, and the gap between the joist end and the header shall not exceed 1/8".
S. Installer of ATS system to cut rods to length as required.
T. Modifications to products or changes in installation procedures should only be made by a qualified designer. The performance of such modified products or an altered installation procedure is the sole responsibility of the designer.

3.3 FIELD QUALITY CONTROL

A. Determine that the proper part is being used in the correct application and has been fabricated by the approved manufacturer by observation of the stamp into the metal part and/or the adhesive label on the product denoting part and manufacturer name.
B. Before substituting another brand, confirm load capacity based on published testing data and calculations per section 2.4. The engineer/designer of record shall evaluate and give written approval for substitution prior to installation.

Table 1
Schedule of Materials

Wood Preservative Treatment	Material
Untreated Lumber – interior dry	Stainless Steel
Untreated Lumber – Interior damp	Stainless Steel
Treated lumber	Stainless Steel

Note: for all connectors, use galvanized G185 if connector is not manufactured in stainless steel.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes:
   1. Wood Framing
   2. Wood Sheathing

1.3 RELATED WORK

A. Wood preservative treated lumber is specified in Section 06 05 73.

1.4 REFERENCES

A. National Forest Products Assoc. (NFPA)
B. American Wood Council: National Design Specification for Wood Construction and Wood Frame Construction Manual.
C. Lumber Standards: Comply with PS 20 and with applicable rules of the respective grading and inspecting agencies for species and products indicated.
D. Southern Forest Products Association (SFPA): Southern Forest Products Association Guide to Southern Pine Lumber Grades
E. American Institute of Timber Construction (AITC): Timber Construction Manual
F. American Wood-Preservers Association (AWPA): AWPA C22-96
G. National Evaluation Report (NES): NER-508
H. Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not manufactured under PS 1 provisions, with applicable APA Performance Standard for type of panel indicated.
I. American Plywood Association - APA Design/Construction Guide Residential and Commercial

1.5 PRODUCT HANDLING

A. Delivery and Storage: Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.

1.6 JOB CONDITIONS

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other work.

PART 2 – PRODUCTS

2.1 LUMBER

A. Factory mark each piece of lumber with type, grade, mill, and grading agency.
B. Lumber Standard: Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of National Design Specification for Wood Construction.
C. All dimensional lumber, engineered lumber and laminated beams shall be preservative treated in accordance with Section 06 05 73

D. Inspection Agencies: Inspection agencies and the abbreviations used to reference them to lumber grades and species include the following:
   1. NLGA National Lumber Grades Authority (Canadian)
   2. SPIB Southern Pine Inspection Bureau
   3. WCLIB West Coast Lumber Inspection Bureau
   4. WWPA Western Wood Products Association

E. Nominal sizes are indicated, except as shown by detail dimensions.
F. Provide dressed lumber, S4S, manufactured to actual sizes required by PS 20 to comply with minimum requirements indicated below:
G. Moisture Content: Seasoned or kiln dried with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
H. Framing Lumber:
   1. For sill plate #2 Southern Pine Treated
   2. For light framing (less than 6" wide) provide "Stud" grade lumber for stud framing and #2 or better" grade for other light framing, Douglas Fir/Larch (WCLB or WWPA).
   3. For structural framing (6" and wider and from 2" to 4" thick), provide #2 or better, Douglas Fir/Larch (WCLB or WWPA).
   4. Roof decking Lumber: Solid Sheathing, No.2 tongue and groove pine. Size and profile to match existing.

2.2 PLYWOOD SHEATHING

A. Trademark: Identify each plywood panel with appropriate APA trademark.
B. Plywood Sheathing: APA RATED SHEATHING
   1. Exposure Durability Classification: Exterior
   2. Span Rating: 32/16
   3. Type: B-C
   4. Thickness: 1/2” or as indicated on drawings.
   5. Preservative treated per Section 06 05 73.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Fasteners shall be Type 304 or Type 316 stainless steel
B. Powder Actuated Fasteners: Hilti, Rawl, Powers, or approved equal

PART 3 – EXECUTION

3.1 ROUGH FRAMING

A. General: Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set rafters and beams with their crown edge up. Frame members for the passage of pipes, conduits and ducts Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spikes, nails and bolts shall be drawn up tight. Do not use shimming on wood or metal bearings. Do not notch in middle third of joists or rafters; limit notches to 1/6-depth of joist, 1/3 at ends. Do not bore holes larger than 1/3-depth of joist or locate closer than 2" from top or bottom.
B. Wall Sheathing: Apply horizontally and stagger vertical end joints. Abut sheathing edges over centerlines of supports. Allow 1/8” spacing at panel ends and ¼” at panel edges. Screw panels to Z furring with #8 stainless steel self-drilling fasteners spaced 8” on center along edges of the panel and 12” on center over intermediate supports, unless otherwise required by drawings.
C. Nailing: Fasten all members in accordance with the IBC fastener schedule, WFCM Nailing Schedule or as specified.

3.2 CLEAN-UP

A. General: Keep premises in a neat, safe and orderly condition at all times during execution of the work, free from accumulation of sawdust, cut ends and debris.
B. Sweeping: At the end of each working day, more often if necessary thoroughly sweep all surfaces where refuse from this portion of the work has settled. Remove the refuse to the area of the job site designated for its storage.
C. Final Clean-Up: Upon completion of the work of this section, thoroughly broom clean all surfaces.

END OF SECTION

SECTION 06 11 41
WOOD NAILERS, CANTS, AND BLOCKING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Installation of all new roof carpentry including nailers, blocking, and wood curbs where detailed.

1.3 RELATED WORK

A. Wood Preservative Treatment is specified in Section 06 05 73.

1.4 REFERENCES

A. The publications listed below form a part of these specifications to the extent applicable:
   1. AITC American Institute of Timber Construction Timber Construction Manual
   2. SFPA Southern Forest Products Association Guide to Southern Pine Lumber Grades
   3. ASTM American Society of Testing Materials
      a. Zinc-coating (Hot Dip) on Iron and Steel Hardware ASTM A153
      b. Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength ASTM A307
   4. FMRC Factory Mutual Research Corporation: Roof assembly classification, Class 1-90 A
   5. NRCA National Roofing Contractors Association - Roofing and Waterproofing Manual
   6. UL Underwriters Laboratories (UL) - Fire Hazard Classification
   7. SMACNA Sheet Metal Air Conditioning Contractors National Association, Inc. (- "Architectural Sheet Metal Manual"

PART 2 – PRODUCTS

2.1 MATERIALS

A. Wood: #2 or better Southern Pine 15% moisture content grade marked in accordance with the Southern Pine Inspection Bureau and preservative treated in accordance with Section 06 05 73. Sizes as shown on drawings.
B. Anchoring Devices, expansion bolts, machine screws in drive-in anchors as manufactured by one of the following; Rawl, Hilti, Ackerman-Johnson Co., All Metal Screw Products Co.
C. Bolts: ASTM A-307
D. Washers: ASTM F436
E. Nuts: ASTM A563 meeting ASTM A23339

2.2 GALVANIZATION

A. All metal items supplied under this Division shall be coated by the hot-dipped process in molten zinc, ASTM A153, G185 unless otherwise specified.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Nailers, blocking, and curbs, shall be as detailed on the drawings securely fastened in place with approved fasteners. Install fasteners in accordance with requirements on the drawings or in the absence, to the requirements of the nailing schedule published in the 2021 International Building Code, New Jersey Edition, or the resist the uplift forces set forth on the drawings, whichever is greater.

END OF SECTION

SECTION 06 17 53
SHOP FABRICATED WOOD TRUSSES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the supply and installation of Prefabricated Wood Roof Trusses.

1.3 RELATED WORK

A. Roof sheathing is specified in Section 06 10 00 "Rough Carpentry".

1.4 DEFINITIONS

A. Prefabricated metal-plate-connected wood trusses include planar structural units consisting of metal-plate-connected members that are fabricated from dimension lumber and that have been cut and assembled prior to delivery to the Project site.

1.5 SUBMITTALS

A. Product data for lumber, metal connector plates, hardware, fabrication process, and fasteners.
B. Provide shop drawings that have been prepared, signed and stamped by a NJ Professional Engineer indicating:
    1. Species and species group, sizes, and stress grades of lumber
    2. Pitch, span, camber, configuration, and spacing
    3. Type, size, material, finish, design values, and location of metal connector plates
    4. Bearing details
    5. Truss framing plan delineating all permanent and erection bracing

C. Submit design analysis indicating loading, allowable stress, stress diagrams and calculations, and other information needed for review that have been signed and sealed by a NJ Professional Engineer responsible for their preparation.
D. Product certificate, signed by officer of fabricating firm, certifying that metal-plate-connected wood trusses supplied for Project comply with specified requirements.
E. Do not fabricate or install trusses until the complete submittal package is reviewed and accepted by the Administrative Building Code Authority.

1.6 QUALITY ASSURANCE

A. TPI Standards: Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:
    1. "Design Specification for Metal Plate Connected Wood Trusses"
    2. "Design Specification for Metal Plate Connected Parallel Chord Wood Trusses"
    3. "Commentary and Recommendations for Handling and Erecting Wood Trusses"
    4. "Commentary and Recommendations for Bracing Wood Trusses"
    5. "Quality Standard for Metal Plate Connected Wood Trusses"

B. Connector Plate Manufacturer's Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Standard for Metal Connector Plate Manufacture".
C. Wood Structural Design Standard: Comply with applicable requirements of N.F.P.A. "National Design Specification for Wood Construction".
D. Single-Source Engineering Responsibility: Provide trusses engineered by the metal plate connector manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a qualified professional engineer.
E. Engineer Qualifications: A professional engineer legally authorized to practice in New Jersey and experienced in providing engineering services of the kind indicated that have resulted in the installation of metal-plate-connected wood trusses similar to those of this Project and with a record of successful in-service performance.
F. Fabricator's Qualifications: A firm that complies with the following requirements for quality control and is experienced in prefabricating metal-plate-connected wood trusses similar to those of this Project that have a record of successful in-service performance:
G. Fabricator participates in a recognized quality assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute; or other independent inspection and testing agency acceptable to Architect and authorities having jurisdiction.
H. Single Source Responsibility for Connector Plates: Provide metal connector plates from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses with care and comply with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning, or other cause which trusses are not designed to resist or endure.

1.8 SEQUENCING AND SCHEDULING

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

1.9 DELEGATE DESIGN

A. The design and comprehensive engineering of the prefabricated truss system shall be performed by a qualified professional engineer, licensed in the state of new jersey. Engineering shall be based on the performance requirements listed within these Design Documents.
B. Signed and sealed engineering calculations and drawings shall be submitted for the prefabricated truss system prior to installation.

PART 2 – PRODUCTS

2.1 CONNECTOR PLATE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide metal connector plates by one of the following:
    1. Alpine Engineered Products, Inc.
    2. Gang-Nail Systems, Inc.
    3. Truss- Systems Corporation
    4. Or Approved equal

2.2 LUMBER

A. Factory mark each piece of lumber with type, grade, mill, and grading agency.
B. Lumber Standard: Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
C. Inspection Agencies: Inspection agencies and the abbreviations used to reference them to lumber grades and species include the following:
    1. SPIB - Southern Pine Inspection Bureau
    2. WCLIB - West Coast Lumber Inspection Bureau
    3. WWPA - Western Wood Products Association

D. Nominal sizes are indicated, except as shown by detail dimensions.
E. Provide dressed lumber, S4S, manufactured to actual sizes required by PS 20 to comply with minimum requirements indicated below:
    1. Moisture Content: Seasoned, with 15 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
        a. Grade for Chord Members: "No. 1" or better
        b. Grade for Web Members: "No. 2" or better
        c. Species: Any species graded under WWPA, WCLIB, or SPIB rules.

2.3 METAL CONNECTOR PLATES

A. General: Fabricate connector plates from metal complying with requirements indicated in this article.
    1. Hot-Dip Galvanized Steel Sheet: Structural (physical) quality steel sheet complying with ASTM A 446, Grade A; zinc coated by hot-dip process to comply with ASTM A 525, Designation G185.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
    1. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
    2. Nails, Wire, Brads, and Staples: FS FF-N-105
    3. Power Driven Fasteners: National Evaluation Report NER-272
    4. Wood Screws: ANSI B18.6.1
    5. Lag Bolts: ANSI B18.2.1
    6. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.
    7. Fasteners used with trusses fabricated from FTW lumber shall be ANSI Type 304 stainless steel.

2.5 METAL FRAMING ANCHORS

A. General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
B. Current Evaluation/Research Reports: Provide products for which reports exist from a model code organization acceptable to authorities having jurisdiction that evidence compliance of metal framing anchors for application indicated with the building code in effect for this Project.
    1. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.

C. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A 525 for Coating Designation G60 and with ASTM A 446, Grade A (structural quality); ASTM A 526 (commercial quality); or ASTM A 527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.

2.6 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints with wood-to-wood bearing in assembled units.
B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.
C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances specified in TPI "Quality Standard for Metal Plate Connected Wood Trusses". Position members to produce design camber indicated
D. Connect truss members by means of metal connector plates accurately located and securely fastened to each side of wood members by means indicated or approved.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Erect and brace trusses to comply with applicable requirements of referenced TPI standards.
B. Where trusses do not fit, return them to fabricator and replace with trusses of correct size; do not alter trusses in the field.
C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacings indicated.
D. Hoist trusses in place by means of lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
E. Temporary Bracing: Truss shall be erected by mechanical means. Install temporary bracing as the work progresses to avoid toppling and to keep trusses in proper alignment. Temporary bracing shall remain in place until the roof deck is secured and all permanent bracing is installed.
    1. Top chord plane: Install three (3) rows 2 x 10 continuous bracing one within 6" of the ridge, at mid top chord and at eaves on both sides of pitch. Bracing shall be continuous over at least three (3) trusses. At each end of the building, install a diagonal brace between the top and mid chord brace and the mid chord brace and eave brace at a 45 degree angle. Ends of brace shall terminate at different trusses.
    2. Bottom Chord Bracing: Install temporary bracing in the plan of the bottom chord. Bracing shall be on 10' centers and shall run the entire length of the building. Install diagonal bracing between laterals at a 45 degree angle at both ends.
    3. X-Bracing: Install diagonal "X" bracing between top and bottom chords of first two trusses 10' on center, centered on the ridge.

F. Anchor trusses securely at all bearing points to comply with methods and details indicated.
G. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
H. Do not cut or remove truss members.

END OF SECTION

SECTION 06 20 23
INTERIOR FINISH CARPENTRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. This Section includes the supply and installation of finished carpentry items including:
   1. Window extension jambs
   2. Window casings
   3. Window sills
   4. Wood base boards
   5. Wood moldings
   6. Miscellaneous wood trim

1.3 REFERENCES

A. The publications listed below form a part of these Specifications to the extent applicable:
   1. National Forest Products Assoc. (NFPA)
      a. National Design Specification for Wood Construction
   2. Western Wood Products Association (WWPA): WWPA Grading Rules

PART 2 – PRODUCTS

2.1 LUMBER MATERIALS

A. window casing, extension jambs and trim: Clear White Pine Kiln Dried to 12 % moisture content, grade marked by the Western Wood Products Association, size and profile shall be as shown on the drawings.
B. baseboards and trim shall be clear White Pine kiln dried to 12 % moisture content, size and profile shall be as shown on the drawings.

2.2 ACCESSORIES

A. Nails for interior use: Commercial quality “bright” finishing nails
B. Adhesive: Waterproof Type 1

2.3 CLOSET SHELVING

A. Wire Shelving: Heavy gauge vinyl coated steel shelving with integral hanging bar, painted steel wall brackets with 100 pound support capacity. Support brackets maximum 36” on center, with a minimum of two brackets per shelf. Coordinate for solid blocking to be installed in wall for attachment of shelving. Provide three full length shelves per walls indicated on the drawings per closet.

PART 3 – EXECUTION

3.1 INSTALLATION OF INTERIOR TRIM

A. Trim called for by drawings shall be provided and installed with tight joints, securely nailed using blind nailing where possible. Set all exposed nails for finishing by others.
B. Obtain trim in longest lengths practicable to avoid joints. Where it becomes necessary to join straight sections of moldings and trim, splice using 45-degree angle cuts.
C. Miter, cope, and glue corner joints.
D. Trim and woodwork shall be sanded as necessary to remove irregularities and machine marks. All work shall be left free of blemishes and defects.

END OF SECTION

SECTION 06 61 00
FIBERGLASS COLUMNS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. The Scope of this section includes the provision and installation of new fiberglass column covers for the exterior entrance canopy.

1.3 REFERENCES

A. Applicable Standards: Standards of the following, as referenced herein:
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)

1.4 SUBMITTALS

A. Shop drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
B. Samples: Submit sample of column cross section.
C. Product data: Indicate product description, including all pertinent data to show compliance with the requirements set forth in this section.

1.5 QUALITY ASSURANCE

A. The components incorporated into the drawings show dimensions and styles chosen to accomplish the Architect's intended aesthetic result and to conform to the building's configuration in both form and function. The Contractor shall verify that all components to be provided by the manufacturer for the work of this section will fit the building's structural elements and meet the visual design criteria on the drawings without materially altering profiles and alignments.
B. Any additional support or backing components shall be provided by the installation contractor as part of the work of this section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name & identification of manufacturer or supplier. Customer to unload and store materials onsite under cover and
B. in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion, and damage from construction traffic and other causes. Split Columns shouldn't be stored for longer than 7 days.
C. Handle materials and products to prevent damage to edges, ends, or surfaces
D. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

A. Provide manufacturer’s lifetime warranty against defects in materials and workmanship.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The Basis-of Design is Royal Corinthian of West Chicago Illinois. Tapered Tuscan style. The following manufacturers' products will be acceptable provided that they meet or exceed the requirements specified herein and provide the same profiles as shown on the drawings:
   1. Melton Classics
   2. GC Products, Inc.
   3. Approved Equal

B. If additional work is required to utilize the alternate manufacturers' products, any additional costs will be included in the base contract cost.
C. PVC: Cellular PVC
D. Cap/Base: Cellular PVC

2.2 FIBERGLASS, RESIN, AND FILLER MATERIALS

A. Glass chop shall be equal to the products of PPG-Owens Corning.
B. Polyester resins shall be general purpose. The resin will be flame retardant polyester resin designed for use in the roto-cast method.
C. Filler material shall be General Purpose or ASTM E 84-01 Class A rated.
D. Final ratio of materials shall consist of fiberglass chop, polyester resin, and filler.
E. Shaft thickness shall be 3/8" to 1" depending on size.
F. Allowable Tolerances
   1. Wind Load Resistance:
      a. Fiberglass components when installed shall resist wind loading.
      b. Minimum wind loading requirements as per standard building code.

   2. Dimensional Tolerances of Finished Units
      c. (1) Dimensions 10' or under: +/- 1/4". (2) Dimensions 10' to 20': +/- 1/4".
      d. Out of Square: 1/8" per 6.'
      e. Shaft height: up to 1" taller than nominal unless cut to OAH is specified.
      f. Column diameters and widths are nominal

PART 3 – EXECUTION

3.1 JOB MOCK-UP

A. Prior to final approval of shop drawings, erect one full size mock-up of each component at Project site for Architect's review.
B. Should mock-up not be approved, rework or remake until approval is secured. Remove rejected units from Project site.
C. Approved mock-ups shall remain as part of finished work.

3.2 INSTALLATION

A. Follow manufacturers detailed installation guidelines and Product technical bulletin.
B. Install sealant for all joints that ARE a high-end construction adhesive that is paintable and flexible.
C. Fiberglass Columns are recommended to be sanded, primed, and painted.
D. All installations shall be as per manufacturer's specifications.

END OF SECTION

SECTION 06 65 00
SIMULATED WOOD TRIM

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 SECTION INCLUDES

A. This Section includes:
   1. Custom fabrications and trim fabricated from cellular polyvinyl chloride including:
      a. Exterior trim
      b. Widow Heads
      c. Fascias
      d. Decorative frieze
      e. Soffits and ceilings

B. Related work included in other sections:
   1. Cellular PVC column enclosure is specified in Section 06 61 00.
   2. Painting is specified in Section 09 90 00.

1.3 REFERENCES

A. ASTM D792 - Density and Specific Gravity of Plastics by Displacement.
B. ASTM D570 - Water Absorption of Plastics.
C. ASTM D638 - Tensile Properties of Plastics.
D. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
E. ASTM D1761 - Mechanical Fasteners in Wood.
F. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by means of a Striker Impacted by a Falling Weight.
G. ASTM D256 - Determining the Pendulum Impact Resistance of Plastics.
H. ASTM D696 - Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer.
I. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
J. ASTM E84 - Surface Burning Characteristics of Building Materials.
K. ASTM D648 - Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

1.4 SUBMITTALS

A. General: Submit listed submittals in accordance with Condition of the Contract and Division 1 Submittal Procedures Section.
B. Product Data: Submit product data, manufacturer's catalogs, product sheet, for specified products.
C. Shop Drawings: Submit complete shop drawings of all items supplied under this section.

1.5 QUALITY ASSURANCE

A. Allowable Tolerances:
Variation in component length: -0.00 / +1.00”
Variation in component width: ± 1/16"
Variation in component thickness: ± 1/16"
Variation in component edge cut: ± 2°
Variation in Density: -0% + 10%

B. Workmanship, Finish, and Appearance: Free foam cellular PVC that is homogenous and free of voids, holes, cracks, and foreign inclusions and other defects. Edges must be square, and top and bottom surfaces shall be flat with no convex or concave deviation. Uniform surface free from cupping, warping, and twisting.

1.6 DELIVERY, STORAGE AND HANDLING

A. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

1.7 WARRANTY

A. Provide manufacturer’s 25 year warranty against defects in manufacturing that cause the products to rot, corrode, delaminate, or excessively swell from moisture.

PART 2 – PRODUCTS

2.2 CELLULAR POLYVINYL CHLORIDE TRIM

A. Material: Free foam cellular PVC material with a small-cell microstructure and density of grams/cm3
B. Performance and physical characteristic requirements:

PROPERTY UNITS VALUE ASTM METHOD PHYSICAL	
Density	g/cm3 0.55 D 792
Water Absorption %	0.15 D 570
Tensile Strength psi	2256 D 638
Tensile Modulus psi	144,000 D 638
Flexural Strength psi	3329 D 790
Flexural Modulus psi	144,219 D 790
Nail Hold lbf/in of penetration	35 D 1761
Screw Hold lbf/in of penetration	680 D 1761
Staple Hold lbf/in of penetration	180 D 1761
Gardner Impact in-lbs	103 D 5420
Charpy Impact (@23°C) ft-lbs	4.5 D 256
Coefficient of Linear Expansion in/in/°F	3.2 x 10-5 D 696
Burning Rate in/min No burn when flame removed D.	635
Flame Spread Index	25 E 84
Heat Deflection Temp 264 psi °F	150 D 648
Oil Canning (@140°F) °F	Passed D 648

C. Provide material in the size and thickness as delineated on the drawings.

2.3 ACCESSORY PRODUCTS

A. Fasteners:
   1. Use fasteners designed for wood trim and wood siding (thinner shank, blunt point, full round head)
   2. Use a highly durable fastener such as stainless steel or hot-dipped galvanized.
   3. Staples, small brads and wire nails must not be used as fastening members.
   4. The fasteners should be long enough to penetrate the solid wood substrate a minimum of 11/2".
   5. Use 2 fasteners per every framing member for trim board applications. Trim boards 12" or wider, as well as sheets, will require additional fasteners.
   6. Fasteners must be installed no more than 2" from the end of the board.
   7. Fasten into a flat, solid substrate. Fastening into hollow or uneven areas must be avoided.
   8. 3/8" and 1/2" sheet product is not intended to be ripped into trim pieces. These profiles must be glued to a substrate and mechanically fastened.

B. Adhesives:
   1. Glue all joints with a cellular PVC cement, to prevent joint separation.
   2. The glue joint should be secured with a fastener and/or fastened on each side of the joint to allow adequate bonding time.
   3. Surfaces to be glued should be smooth, clean and in complete contact with each other.

C. Sealants: Use urethane, polyurethane or acrylic based sealants without silicone.

PART 3 – EXECUTION

3.1 DELIVERY

A. Deliver materials in original packages, containers, or bundles bearing brand name & identification of manufacturer or supplier. Customer to unload and store materials onsite under cover and
B. in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion, and damage from construction traffic and other causes.
C. Handle materials and products to prevent damages to edges, ends, or surfaces.

3.2 CELLULAR POLY VINYL CHLORIDE TRIM

A. Comply with manufacturer's product catalog installation instructions and product technical bulletin instructions.
B. Rabbet sides of all trim to create a J- Pocket to receive plastic siding.
C. At corners wrap a piece of flexible flashing over building paper extending 6" beyond trim.
D. Flexible flashing shall be installed under trim at doors extending 6" beyond trim.

END OF SECTION

SECTION 06 65 10
SOLID POLYMER FABRICATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SCOPE OF WORK

A. The Scope of this section includes the construction of countertops and installation of sinks and cove backsplashes.
B. Related work specified elsewhere:
   1. The Plumbing Contractor shall be responsible to provide all connections, make any modifications to existing plumbing, and provide connections to new plumbing fixtures.

1.3 REFERENCES

A. Applicable Standards: Standards of the following, as referenced herein:
   1. American National Standards Institute (ANSI)
   2. American Society for Testing and Materials (ASTM)
   3. National Electrical Manufacturers Association (NEMA)
   4. Federal Specifications (FS)

1.4 SUBMITTALS

A. Shop drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work. Refer to Execution below for mock-up requirements.
B. Samples: Submit minimum 2" x 2" samples. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work
C. Product data: Indicate product description, fabrication information and compliance with specified performance requirements.
D. Maintenance data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project Close-Out documents.

1.5 QUALITY ASSURANCE

A. Allowable tolerances:
   1. Variation in component size: 1/8".
   2. Location of openings: 1/8" from indicated location.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver no components to Project site until areas are ready for installation. Store components indoors prior to installation.
B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 WARRANTY

A. Provide manufacturer’s 10-year warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

PART 2 – PRODUCTS

2.1 SOLID POLYMER FABRICATIONS

A. Countertops with sinks: 1/2" thick countertop of solid polymer material; edge details as indicated on the Architect's Drawings, opening cut and prepared to accept undermount bathroom sink as specified on Plumbing Drawings. Provide counter complete with backsplash of size shown on the Architect's Drawings. All colors shall be selected by the Architect.

B. Allowable tolerances:
   1. Variation in component size: 1/8".
   2. Location of openings: 1/8" from indicated location

C. Performance characteristics:

PROPERTY	REQUIREMENT (min or max)		TEST PROCEDURE
Tensile Strength	5000 psi min		ASTM D638
Tensile Modulus	1.0 x 106 psi min		ASTM D638
Flexural Strength	7000 psi min		ASTM D790
Flexural Modulus	1.0 x 106 psi min		ASTM D790
Elongation	0.3% min.		ASTM D638
Hardness	90-Rockwell "M" scale min. 52-Barcol Impresser min.		ASTM D758 ASTM D2583
Thermal Expansion	3.5 x 10-6 in/in/deg C. max. 1.95 x 10-6 in/in/deg F. max.		ASTM D696
Color Stability	No change,100 hours min.		NEMA LD3-3.10
Wear and Cleanability	Passes		ANSI Z124.3
Abrasion Resistance	No loss of pattern max. weight loss (1000cycles) =0.9g.		NEMA LD3-3.01 ANSI Z124.3
Boiling water Surface Resistance	No Change		NEMA LD3-3.05
High Temperature Resistance	No Change		NEMA LD3-3.06
Impact Resistance Notched Izod Gardner	 0.24 ft.-lbs.min. 9.0 ft-lbs min.		 ASTM D256, Method A ASTM D3029
Ball drop 1/4" sheet 1/2" sheet 3/4" sheet	 36" min, 1/2 lb ball, no failure 140" min, 1/2 lb ball, no failure 200" min, 1/2 lb ball, no failure		NEMA LD3-303
Bowls (point impact)	No cracks or chips		ANSI Z124.3 and 124.6
Stain Resistance	Passes		ANSI Z124.3
Weatherability	No change,min. 1000 hours		ASTM D1499
Fungi and Bacteria	No Attack		ASTM G21, ASTM G22
Specific Gravity	1.6 min		
Water Absorption Weight (% max.)	 24 hrs. 0.05 0.10	 Long Term 0.50(1/4") 0.90(3/4")	ASTM D570

Flammability		ASTM E84		
		solid colors		
	1/4"	1/2"	3/4"	
Flame spread	25 max	25 max	25 max	
Smoke Developed	30 max	30 max	30 max	
Class	1	1	1	
		particulate patterns		
	1/4"	1/2"	3/4"	
Flame spread	25 max	25 max	25 max	
Smoke Developed	30 max	30 max	30 max	
Class	1	1	1	
Pittsburgh Protocol Toxicity (as used by NY State)	solids-80 gms minimum rating patterns-65 gms minimum			"LC50" Test

2.2 ACCESSORY PRODUCTS

A. Joint adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints,
B. with a chemical bond.
C. 1 ½"x 1 ½" Steel tubing under counter mount system with horizontal support adjacent to the knee brackets
D. 3"x 3"stainless steel end brackets to be incorporated in the steel tubing support system.
E. 1 ½"x 1 ½" steel tubing knee brackets angled at 30 degrees to be located at existing stud walls not to exceed 32" maximum. Attached 1/4" x 3" stainless steel wall plate spanning the entire span of the countertop.

2.3 FABRICATION

A. For warranty coverage, fabricator/installer shall be approved by solid polymer manufacturer.
B. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements.
C. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 2" wide reinforcing strip of solid polymer material under each joint.
D. Provide holes and cutouts for plumbing accessories as indicated on the drawings.
E. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts and sand all edges smooth. Repair or reject defective or inaccurate work.
F. Finish: All surfaces shall have uniform finish.
   1. Matte, with a gloss rating of 5 - 20.

G. Cove backsplashes: Fabricate 1/2" radius cove at intersection of counters and backsplashes. Form backsplashes using 1/2" solid polymer material. Fabricate in shop or field.

PART 3 – EXECUTION

3.1 JOB MOCK-UP

A. Prior to final approval of shop drawings, erect one full size mock-up of each component at Project site for Architect's review.
B. Should mock-up not be approved, rework or remake until approval is secured. Remove rejected units from Project site.
C. Approved mock-ups shall remain as part of finished work.

3.2 INSTALLATION

A. Install components plumb and level, in accordance with approved shop drawings and product installation details.
B. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.
C. Adhere undermount/submount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.
D. Adhere top mount sinks/bowls to countertops using manufacturer recommended adhesives and color-matched silicone sealant.
E. Provide backsplashes and end splashes as indicated on the drawings. Adhere to countertops using manufacturer's standard color-matched silicone sealant.
F. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on the date of Substantial Completion.
G. Make plumbing connections to sinks in accordance with Division 23 Mechanical.
H. Protect surfaces from damage until the date of Substantial Completion. Repair or replace damaged work that cannot be repaired to Architect's satisfaction and invoice for the cost of repairs. Architect to pre-approve cost estimate before repairs are made.
I. Fabricator/Installer is to provide a commercial care and maintenance video, review maintenance procedures and warranty details with the director of maintenance upon completion of Project.
J. All installations shall be as per manufacturer's specifications.

END OF SECTION

SECTION 07 01 50
PREPARATION FOR RE-ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Roof replacement preparation consisting of partial roof tear-off of roof system at designated roof areas
2. Roof rehabilitation preparation of roof system at designated roof areas
3. Removal of flashings and counterflashings
4. Temporary roofing
5. Temporary roof drainage
6. Removal and reinstallation of indicated components, accessories, and equipment
7. Recycling of non-hazardous demolition and construction waste.

1.2 DESCRIPTION OF WORK

A. Re-roofing preparation Work consists of the following:
1. Preparation for: Roof replacement
2. Existing Roof Type: SBS
3. Existing Deck Type: Varies, Refer to Drawings
4. Complete roof tear-off
5. Removal and reinstallation of indicated components, accessories, and equipment
6. Recycling of non-hazardous demolition and construction waste
7. Uplift securement
8. Removal of base flashings
9. Temporary roof membrane

1.3 RELATED WORK

A. The work of this section shall be coordinated with the following sections:
1. 02 06 00 Demolition for Remodeling

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and glossary in applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" for definition of terms related to roofing work in this Section.
B. Partial Roof Tear-Off: Removal of a portion of existing membrane roofing system from deck or removal of selected components and accessories from existing membrane roofing system.
C. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
D. Existing to Remain: Existing items of construction that are not indicated to be removed.
E. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
F. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
G. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

H. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
I. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
J. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.6 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal work, conduct conference at Project site.
   1. The agenda will include the review of the methods and procedures related to roofing tear-off, including, but not limited to, the following:
      a) Reroofing preparation, including roofing system manufacturer's written instructions.
      b) Temporary protection requirements for existing roofing system components that are to remain.
      c) Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
      d) Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
      e) Existing roof deck conditions requiring Architect notification.
      f) Existing roof deck removal procedures and notifications to the Project Team.
      g) Condition and acceptance of existing roof deck and base flashing substrate for reuse.
      h) Structural loading limitations of roof deck during reroofing.
      i) Base flashings, expansion joints, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
      j) HVAC shutdown and sealing of air intakes.
      k) Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
      l) Lead-based component treatment, handling, and disposal requirements

   2. This meeting shall be combined with the Preinstallation Meeting referenced in Section 07 55 00.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane and that its inclusion will not adversely affect the roofing system's resistance to fire and wind or its FM Global rating.

1.8 INFORMATIONAL SUBMITTALS

A. Digital Images or Videos: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, which might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.
B. Schedule of Re-Roofing Preparation Activities: Indicate the following:
   1. Detailed sequence of re-roofing preparation work, with starting and ending dates for each activity. Ensure occupants' on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Coordination of Owner's continuing occupancy of portions of existing building.
   6. This schedule of tasks shall be incorporated into the Baseline Construction Schedule

1.9 PROJECT / FIELD CONDITIONS

A. The building will remain occupied throughout the re-roofing operations.
   1. Conduct reroofing so that building operations will not be disrupted.
   2. Provide the Project Team with not less than 48 hours written notice of activities that may affect the building operations.

3. Coordinate work activities daily with the Project Team and arrange for the provision and placement of protective dust or water leakage covers over sensitive equipment or furnishings, and for Building Management to shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area.
4. Before working over structurally impaired areas of deck, notify Building Management to evacuate occupants from below the affected area.
   a) Verify that occupants below the work area have been evacuated before proceeding with work over the impaired deck area.

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
D. Limit construction loads on roof to rooftop equipment wheel loads and uniformly distributed loads not exceeding recommendations of Contractor's professional engineer based upon site inspection and analysis.
E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
   1. Remove only as much roofing in one day as can be made watertight in the same day.

F. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
G. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 ROOFING INFILL, PATCHING AND REPLACEMENT MATERIALS

A. Use roofing infill materials matching existing insulation roofing system materials unless otherwise indicated. Refer to Section 07 55 00.

2.2 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are responsibilities of Contractor.

2.3 TEMPORARY ROOF DRAINAGE

A. Design and selection of materials for temporary roof drainage are responsibilities of the Contractor.

2.4 AUXILIARY RE-ROOFING MATERIALS

A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new membrane roofing system.

PART 3 - EXECUTION

3.1 PREPARATION, GENERAL

A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.
B. Shut off rooftop utilities and service piping before beginning the Work.
C. Test existing roof drains to verify that they are not blocked or restricted. Refer to Section 01 35 00 Special Project Procedures for pre and post construction drain testing requirements.
   1. Immediately notify Architect of any blockages or restrictions.

D. Coordinate with Building Management to shut down air-intake equipment in the vicinity of the Work.
   1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

E. Pollution Control: Comply with environmental regulations of authorities having jurisdiction. Limit spread of dust and debris.
   1. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   2. Remove debris from building roof by chute, hoist, or other device that will convey debris to grade level. Prior approval of and coordination with Building Management is required for all proposed equipment, access, and staging locations. Refer to Section 01 35 00 Special Project Procedures

F. Temporary Weather Protection: During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain. Tarps and other temporary protection shall not be considered as overnight protection or night seal.

G. Roof Drain Protection: Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
   1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.
   2. Prevent debris from entering or blocking roof drains and conductors.
      a) Use roof-drain plugs specifically designed for this purpose.
      b) Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

   3. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding.
      a) Do not permit water to enter into or under existing membrane roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Complete Roof Tear-Off: Remove existing roofing membrane to structural deck.
   1. Coordinate with Owner's inspector to schedule times for tests and inspections immediately after membrane removal.

   2. Remove any fasteners from deck.

D. Inspect wood blocking, curbs, and nailers for deterioration and damage.
   1. Replace existing wood components that exhibit signs of deterioration or other conditions detrimental to securement of roofing system components, including roof edge flashings.
   2. Reuse of Existing Wood Nailers: Permitted where type, size and securement are in accordance with Factory Mutual Loss Prevention Data Bulletin 1-49; and existing wood nailers exhibit no signs of deterioration or other conditions detrimental to securement of new roofing system in conformance with specified requirements.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of membrane roofing system.

B. Verify that deck is sound and dry.

C. Unsuitable Deck: If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.4 BASE FLASHING REMOVAL

A. Remove existing base flashings where indicated on Drawings.
B. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
C. Do not damage metal counterflashings that are to remain.

3.5 RECYCLING OF DEMOLITION AND CONSTRUCTION WASTE

A. Prevent other materials or debris from intermixing with recycled material.
B. Submit final summary of progress reports, including percentage of recycled waste to quantity of total waste, by weight.

3.6 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Storage or sale of demolished items or materials on-site is not permitted.
B. Transport and legally dispose of demolished materials off Owner's property.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by preparation for re-roofing operations. Return adjacent areas to condition existing before operations began.

END OF SECTION

SECTION 07 21 16
BUILDING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of insulation below grade, rigid insulation, batt insulation where indicated, and foam sealants.

1.3 RELATED WORK

A. For Spray-Applied Insulation refer to Section 07 21 29.
B. For the supply and installation of rooftop insulation refer to Section 07 55 00.

1.4 QUALITY ASSURANCE

A. Thermal Conductivity: Thickness indicated are for thermal conductivity (k-value at 75 degrees F) specified for each material. Provide adjusted thickness as directed for equivalent use of material having a different thermal conductivity. Where insulation is identified by "R" value, provide thickness required to achieve indicated value.
B. Toxicity/Hazardous Materials
   1. Provide products that contain no urea-formaldehyde
   2. Products and equipment requiring or using CFCs, HCFCs, or HFCs during the manufacturing or application process will not be permitted
   3. Provide products that contain no PBDEs
   4. Provide products that are “Low-emitting”

1.5 PRODUCT HANDLING

A. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

1.6 SUBMITTALS

A. Product Data for each type of insulation product specified.
B. Product test reports performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Glass Fiber Blanket/Batt Insulation: Inorganic (non-asbestos) fibers formed with binders into resilient flexible blankets or semi-rigid batts; FS HH-I-521, Type as indicated, densities of not less than 0.5 lb. per cu. ft. for glass fiber units units, k-value of 0.27; manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated; types as follows:
   1. Thermal wall and ceiling insulation (where covered by gypsum board): Provide kraft vapor barrier faced units, with integral nailing flanges; barrier rating of 1.0 perms, other face (if any) with rating greater than 5.0 perms.

B. Extruded Polystyrene Board Insulation: For use below slab. Rigid, closed-cell extruded polystyrene insulation board complying with ASTM C578, Type IV, minimum 25 psi compressive strength, R-5 per inch of thickness. Maximum water absorption pf .10 % by volume. Water vapor permeance of 1.5 perm. Provide in manufacturer's standard lengths and widths.

C. Extruded Polystyrene Board Insulation: For use below slab. Rigid, closed-cell extruded polystyrene insulation board complying with ASTM C578, Type IV, minimum 25 psi compressive strength, R-5 per inch of thickness. Maximum water absorption pf .10 % by volume. Water vapor permeance of 1.5 perm. Provide in manufacturer's standard lengths and widths.

D. Rigid Insulation for Interior face of Masonry Walls: Polyisocyanurate insulation boards in thickness indicated on drawings having a minimum R-value of R-6.0 per inch of thickness. Water absorption less than 1% by volume, and complying with ASTM C1289. Panels shall be Type II with glass fiber mat facers.

E. Acoustic Insulation: 3” 2.5 pound per square foot density mineral fiber sound insulation type 1 ASTM C665, with 0 smoke developed index and 0 flame spread index per ASTM E84.

F. Roof Insulation: Refer to Specification 07 55 00.

G. Mechanical Anchors: 1/4” steel staples or other type fastener recommended by insulation manufacturer for type of application and condition of substrate.

H. Foam Sealant Insulation: UL classified minimal expanding foam sealant with a flame spread and smoked developed rating not exceeding 20.

I. Interior Moisture Barrier: Polyethylene sheet not less than 6 mils thick.

J. Adhesive: As recommended by insulation board manufacturer.

K. Tape: Pressure sensitive joint sealing tape.

PART 3 – EXECUTION

3.1 INSPECTION AND PREPARATION

A. Inspection: Installer must examine substrates and conditions under which insulation work is to be performed, and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with insulation work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Preparation: Clean substrates of substances harmful to insulations or vapor barriers, including removal of projections which might puncture vapor barriers.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult with manufacturer's technical representative for specific recommendations before proceeding with work.
   1. Extend insulation full thickness over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
   2. Apply a single layer of required thickness, unless otherwise shown or required to make up total thickness.
   3. Set vapor barrier faced units with vapor barrier to warm side of construction, except as otherwise shown. Do not obstruct ventilation spaces, except for fire-stopping.

4. Stuff loose mineral fiber insulation into miscellaneous voids and cavity spaces. Compact to approximately 40% of normal maximum volume (to density of approximately 2.5 lbs. per cu. ft.)
5. Seal joints/seams in vapor barriers, seal to objects penetrating barriers, and seal to other surfaces at extremities of coverage by lapping with adhesive or taping to form a continuous barrier.
6. Repair punctures and tears in vapor barriers, immediately before concealment by other work.
7. Install foam sealant to fill tight voids on the interior of the building envelope as occur between window frames and building structure and similar spaces. Install foam sealant in accordance with the manufacturer's installation instructions to fill only 50% of the void and allow to expand.

END OF SECTION

SECTION 07 24 00
EXTERIOR FINISH SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for proper design, use, and installation of an Exterior Insulation and Finish System (EIFS)

1.3 RELATED WORK:

A. Joint Sealants are specified in Section 07 92 00.

1.4 REFERENCES

A. Armstrong Flooring Technical Manuals
B. ASTM B117 Test Method for Salt Spray (Fog) Testing
C. ASTM C203 Standard Teat Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
D. ASTM C1135 Test Method for Determining Tensile Adhesion Properties of Structural Sealants
E. ASTM D968 Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
F. ASTM D1037 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
G. ASTM D2247 Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity
H. ASTM D2294 Standard Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal).
I. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials.
J. ASTM E108 Standard Test Methods for Fire Tests of Roof Coverings
K. ASTM E119 Standard Test Method for Fire Tests of Building Construction and Materials.
L. ASTM E330 Test Method for Structural Performance by Uniform Static Air Pressure Difference.
M. ASTM E331 Test Method for Water Penetration by Uniform Static Air Pressure Difference.
N. ASTM E695 Method for Measuring Relative Resistance to Impact Loading.
O. ASTM E2134 Standard Test Method for Evaluating the Tensile-Adhesion Performance of an Exterior Insulation and Finish System (EIFS)
P. ASTM E2273 Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
Q. ASTM E2430 Standard Specification For Expanded Polystyrene (“EPS”) Thermal Insulation Boards For Use In Exterior Insulation and Finish Systems (“EIFS”)
R. ASTM E2485 Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings
S. ASTM E2486 Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
T. ASTM E2568 Standard Specification for Exterior Insulation and Finish Systems
U. ASTM G155/ Accelerated Weathering for Exposure of Nonmetallic Materials. G153
V. Fed. Spec. Coating,Textured (For Interior and Exterior Masonry Surfaces) TT-C-555B X. MIL STD 810B Military Standard, Environmental Test Methods

1.5 SUBMITTALS

A. Submit shop drawings and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
B. Submit samples, evaluation reports, and certificates in accordance with Division 1 requirements.
C. Warranty: Provide Manufacturer’s standard Warranty. This is to include Material and Labor and Drainage warranties of 10 years minimum.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: provide types of EIFS panels and accessories supplied by one manufacturer.
B. Installer Requirements:
    1. Must possess a current Manufacturer’s certificate of education.
    2. Must be experienced and competent in installation of plaster-like materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
C. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer.

1.8 PROJECT CONDITIONS

A. Installation Ambient Air temperature: Minimum of 40Degrees F. this temperature must be held for 24 hours following installation.
B. Substrate Temperature: Do not apply materials to substrates whose temperatures are below 40Degrees F. or contain frost or ice.
C. Inclement Weather: Do not apply materials during inclement weather unless appropriate protection is employed.
D. Sunlight Exposure: Avoid, when possible, installation of the materials in direct sunlight. Application of Acrylic Finishes in direct sunlight in hot weather may adversely affect aesthetics.
E. Materials shall not be applied if ambient temperature exceeds 120°F (49°C) or falls below 40°F (4°C) within 24 hours of application. Protect materials from uneven and excessive evaporation during hot, dry weather.
F. Prior to installation, the substrate shall be inspected for surface contamination, or other defects that may adversely affect the performance of the materials and shall be free of residual moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Secondary Water-Resistive Barrier: To be compliant with all applicable codes. Flashing membrane to be self-sealing, polyester faced, rubberized asphalt membrane. Size to match existing.
B. Insulation Board:
    1. Shall conform to ASTM C578 and ASTM E2430, Type 1.
    2. Size to match existing.
    3. Thickness as detailed on the drawings.

C. Base Coat: 100% acrylic polymer base.
D. Reinforcing Mesh: Intermediate impact resistance. Weight of 12oz per square yard to achieve ASTM E2486 impact strength.
E. Primer: 100% acrylic-based coating for preparation of exposed finishes.
F. Finish: 100% acrylic polymer-based finish, factory blended. Color and texture to match existing.

G. Water: Clean, cool, potable water.
H. Portland Cement: ASTM C150, Type 1 or 2.

2.2 ACCESSORIES

A. Substrate Materials: (Match Existing)
    1. Glass Mat Gypsum Sheathing to conform with ASTM C1177
    2. Cement Fiber Sheathing to conform with ASTM C1186
    3. Gypsum Sheathing: Minimum 1/2" thick, core treated, weather resistant, exterior gypsum sheathing complying with ASTM C79.
    4. Plywood: Minimum 7/16" thick exterior grade or PS1, Exposure 1, minimum 7/16" thick. Panels gapped 1/8" in at all edges.

B. Drainage Mat: 3-dimensional drainage.
C. Sealant System:
    1. Low Modulus, designed for minimum 100% elongation and minimum 50% compression.
    2. Expansion Joints: 3/4" spacing between EIFS Panels.
    3. Conform to ASTM C920, Grade NS
    4. Color: Match existing.

D. Flashing: Flashing shall be continuous and watertight.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product instructions for installation and maintenance procedures as needed.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify conditions are acceptable for product installation in accordance with manufacturer's instructions.
B. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
C. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the installation. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

3.3 PREPARATION

A. Protection: Protect surrounding material surfaces and areas during installation of system.
B. Clean surfaces thoroughly prior to installation.
C. Prepare surfaces using methods recommended by the Manufacturer for achieving the best result for the substrate under the Project conditions.

3.4 INSTALLATION

A. General: Installation shall conform to the Manufacturer's instructions.
B. Drainage Accessories and Water Resistive Barrier: Install drainage tracks, back-wrap mesh, or edge-wrap mesh at system terminations.
C. Flash all rough openings with water-resistive barrier and embedded Sheathing Tape or Peel and Stick Flashing Membrane
D. Install water resistive barrier in accordance with manufacturer's instructions making all laps weatherboard fashion to provide continuity of watershedding.
E. Install drainage mat with temporary fasteners to hold in place until insulation board is mechanically fastened.
F. Insulation Board: Install fasteners to secure insulation board to the wall in accordance with Manufacturer's instructions. For exterior grade gypsum sheathing and glass mat gypsum sheathing minimum screw penetration of framing members shall be 3/4 in (19 mm) into wood and three full threads through steel. Minimum eight (8) fasteners per 2' x 4' (610 mm x 1219 mm) piece of insulation board.
G. Install insulation board without gaps in a running bond pattern and interlocked at corners.
H. Rasp irregularities off insulation board.
I. Apply primer to base coat after drying.
J. Finish Coat: Apply finish coat to match specified finish type, texture, and color. Do not apply finish coat to surfaces to receive sealant. Keep finish out of sealant joint gaps.

3.5 CLEAN-UP

A. Removal: Remove and legally dispose of EIFS materials from job site.
B. Clean surfaces and work area of foreign materials resulting from material installation.

3.5 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.
B. Provide protection of installed materials from dust, dirt, precipitation, and freezing during installation, and continuous high humidity until fully cured and dry.
C. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Project Designer/Owner.

END OF SECTION

SECTION 07 31 13
ASPHALT SHINGLE ROOFING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Asphalt-fiberglass roofing shingles
B. Leak barrier and roof deck protection
C. Metal flashing associated with shingle roofing

1.3 SUMMARY

A. The work under this Section includes the supply and installation of roof shingles, underlayments, and accessories.

1.4 RELATED SECTIONS

A. Section 06 05 73 - Wood Preservative Treatment for wood nailers and blocking.
B. Section 07 62 00 - Flashing and Sheet Metal
C. Section 07 71 23 - Manufactured Gutters and Leaders
D. Section 07 92 00 - Joint Sealants

1.5 REFERENCES

A. American Society for Testing and Materials (ASTM) - Annual Book of ASTM Standards
    1. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
    2. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
    3. ASTM B 370 - Standard Specification for Copper Sheet and Strip for Building Construction
    4. ASTM D 3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules
    5. ASTM D 3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method)
    6. ASTM D 3462 – Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
    7. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
    8. ASTM D 7158 - Standard Test Method for Wind-Resistance of Sealed Asphalt Shingles (Uplift Force/Uplift Resistance Method)

B. ASTM E 903 – Standard Test Method for Solar Absorptance, Reflectance, and Transmission of Materials Using Integrating Spheres.
C. ASTM E 903 – Standard Test Method for Solar Absorptance, Reflectance, and Transmission of Materials Using Integrating Spheres
D. Underwriters Laboratories (UL) - Roofing Systems and Materials Guide (TFWZ.R21)
    1. UL 790 - Tests for Fire Resistance of Roof Covering Materials
    2. UL 997 - Wind Resistance of Prepared Roof Covering Materials
    3. UL 2218 – Impact Resistance of Prepared Roof Coverings Materials

E. Asphalt Roofing Manufacturers Association (ARMA)

F. Sheet Metal and Air Conditioning Contractors National Association, 1nc. (SMACNA) - Architectural Sheet Metal Manual.
G. National Roofing Contractors Association (NRCA)

1.6 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

1.7 SUBMITTALS

A. Product Data: Submit technical product data, installation instructions and recommendations from shingle manufacturer, including data that materials comply with requirements.
B. Samples: Submit full range of samples for color and texture selection.
C. Maintenance Stock: 2% of each type/color/texture shingle used in the work.
D. Test reports showing that the system meets Class "A" requirements as tested in accordance with ASTM E108 or UL 709, shall be provided as a submittal for the roofing system.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all primary roofing products, including shingles, underlayment, leak barrier, and ventilation, by a single manufacturer.
B. Installer Qualifications: Installer must be approved by the roofing manufacturer for installation of all roofing products to be installed under this section.

1.9 REGULATORY REQUIREMENTS

A. Provide a roofing system achieving an Underwriters Laboratories (UL) Class A fire classification.
B. Install all roofing products in accordance with all federal, state and local building codes.
C. All work shall be performed in a manner consistent with current OSHA guidelines.

1.10 PREINSTALLATION MEETING

A. A pre-installation meeting is required prior to installation of the roofing system.
B. Attendees: Meeting's mandatory attendees shall include the General Contractor, certified roofing contractor, manufacturer's representative, and the project Architect.
C. Topics: Certified Contractor and manufacturer's representative shall review all pertinent requirements for the project, including but not limited to, scheduling, weather considerations, project duration, and requirements for the specified warranty.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Store all products in manufacturer's unopened, labeled packaging until they are ready for installation.
B. Store products in a covered, ventilated area, at temperature not more than 110 degrees F (43 degrees do not store in direct sunlight.
C. Store bundles on a flat surface. Maximum stacking height shall not exceed Manufacturers. recommendations. Store all rolls on end.
D. Store and dispose of solvent-based materials in accordance with all federal, state and local regulations.

1.12 WEATHER CONDITIONS

A. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with Manufacturer's recommendations.

B. Follow Manufacturer's Canadian cold weather installation procedures for installations from September 1st to April 1st.

1.13 WARRANTY

A. Provide, to the Owner, the manufacturer's warranty. The wind exclusion shall not be less than the wind uplift or windspeed rating specified on the drawing Title Sheet, with no reductions applied.
B. Material Manufacturing Defects: Warranty shall provide 100% coverage for materials and labor for repair or replacement of defective roofing materials the first 50 years, then prorated thereafter.
C. Workmanship (Misapplication) Errors: Warranty shall provide 100% coverage for workmanship errors for the first 20 years.
D. Wind Coverage: Warranty shall provide 15 years coverage for replacement of wind damaged or blown-off shingles and to seal any unsealed shingles for up to 130MPH windspeed.
E. Algae Resistance: Warranty shall provide 10 years non-prorated protection against algae discoloration.
F. Installer must register and pay for the warranty.
G. **Refer to Article 01 78 36:1.3(C) for additional warranty requirements**.

1.14 MANUFACTURER'S SERVICES

A. Contractor shall schedule at start-up, at least one interim inspection and final inspection with the Manufacturer's Technical Representative.

PART 2 – PRODUCTS

2.1 SHINGLES

A. Granule surfaced self-sealing laminated multi-layer, asphalt-fiberglass shingle with a strong fiberglass reinforced core and a mineral granule surfacing. Wood shake appearance with 5 5/8 in. exposure. ANSI/UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Class F; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98.
B. Roof shingle assembly shall be warranted to a minimum 130 MPH windspeed (3-second gust).

2.2 RIDGE VENT AND RIDGE SHINGLES

A. Ridge Shingles: High profile, double-layer, self-sealing hip and ridge cap shingle, with 8" exposure, matching the color of selected roof shingle. ASTM D3018, Type 1, ASTM D3161, Class A and F. Install with sealant in accordance with manufacturer's instructions.
B. Ridge Vent: Rigid filtered plastic ridge vent 11 ½" in width, providing 18 square inches of free area per linear foot. GAF Cobra Rigid Vent 3 or approved equal.
foot of vent. Extend ridge vent material continuous to end of roof ridge.

2.3 STARTER STRIP

A. Self-sealing starter shingle designed for premium roof shingles. Full sheet size shall be 17" x 40".

2.4 LEAK BARRIER / ICE AND WATER BARRIER

A. Self-adhering, self-sealing, polymer modified bituminous leak barrier surfaced with fine, skid-resistant granules. UL Classified and meeting or exceeding the performance criteria of ASTM D1970.

2.5 SHINGLE UNDERLAYMENT

A. Premium, water repellant, breather type non-asphaltic underlayment. UV stabilized polypropylene construction. Meets or exceeds ASTM D226 and D4869. Permeance rating of 16 perms at 82 degrees F and 50% relative humidity.

2.6 ROOFING CEMENT

A. Asphalt Plastic Roofing Cement meeting the requirements of ASTM D 4586, Type I or II

2.7 NAILS

A. Nails: Series 300 stainless steel, Aluminum, or hot-dip galvanized (ASTM A641) steel 11 or 12-gage sharp pointed conventional roofing nails with barbed shanks, minimum 3/8" diameter head, and of sufficient length to penetrate minimum 3/4" into solid decking or to penetrate through plywood sheathing a minimum of 1/8". Use only stainless-steel nails where nailing penetrates metal flashings.

2.8 COIL NAILS

A. Type 304 or 316 Stainless Steel.

2.9 METAL FLASHING

A. Flashing material associated with asphalt shingle roofing is specified in Section 07 62 00.

2.10 EAVE VENT

A. Eave vent shall be strip vent type formed from heat-resistant polypropylene. Vent sections shall be crush resistant and shall be 1" x 1 1/2" x 48" long with vertical flute orientation. Eave vent strip shall provide a minimum of 14.34 square inches of net free ventilation air (NFVA) per linear foot.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the roof deck has been properly prepared.
B. If roof deck preparation is the responsibility of another installer, notify the Architect or building Owner of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Verify that the deck is dry, sound, clean and smooth. It shall be free of any depressions, waves, and projections. Cover with sheet metal, all holes over 1 inch in diameter, cracks over 1/2 inch in width, loose knots and excessively resinous areas.
B. Clean deck surfaces thoroughly prior to installation of eave protection membrane and underlayment.

3.3 INSTALLATION OF UNDERLAYMENTS

A. General: Install using methods recommended by the roofing manufacturer, in accordance with the International Building Code 2021.
B. Eaves:
    1. Install eave edge metal flashing tight with fascia; lap joints 2 inches and seal with plastic cement; nail at the top of the flange.

2. Install leak barrier (Ice and Water Barrier) up the slope from eave edge a full 36 inches and to at least 24 inches beyond the interior face of all exterior walls. Lap ends 6 inches and bond.

C. Hips and Ridges:
   1. Install leak barrier (Ice and Water Barrier) along entire lengths. Position the leak barrier so that the ridge vent slots will not be covered.

D. Roof Deck:
   1. Install two layers of underlayment horizontally over the entire area shingle style overlapping where roof sheathing is not protected by leak barrier at the eaves. Install sheets horizontally so water sheds and nail in place.
   2. Utilize only plastic cap nails or staples with plastic caps to secure underlayment. Do NOT use staples or nails without caps.
   3. Lap horizontal edges at least 19 inches and at least 19 inches over eaves protection membrane.
   4. Lap ends at least 4 inches. Stagger end laps of each layer at least 36 inches.
   5. Vertical walls: Install eave protection membrane extending at least 6 inches up the wall and 12 inches on to the roof surface. Lap the membrane over the roof deck underlayment.
   6. Rake Edges: Install metal edge flashing over eave protection membrane and roof deck underlayment; set tight to rake boards; lap joints at least 2 inches and seal with plastic cement; secure with nails.

E. Open Valley: following manufacturer's installation requirements and as specified herein:
   a. Extend starter and first course a minimum of 6" into valley.
   b. Do not nail shingles within 6" of valley centerline. Taper cut shingles so a minimum of 6" coverage into the valley on each side is maintained.
   c. Seal shingles after they have been cut with plastic roofing cement.
   d. Run continuous bead of sealant over flashing and under shingles at leading edge from top to bottom of valley.

F. Ridge Vent:
   1. Cut a 1.5" slot through and remove the OSB board from roof panel along both sides of the ridge. Leave an uncut (closed) sheathing area of 6" at each end of the ridge.
   2. Install Ridge Vent by applying a bead of sealant on the shingles and nailing the vent into place with nails as recommended by the manufacturer. Install vent along the ENTIRE length of ridge, covering the uncut sheathing areas on both ends.
   3. Install ridge shingles directly over Ridge Vent. Use roofing nails of sufficient length to penetrate just through vent into the OSB, on centers recommended by the shingle manufacturer. Do not drive nails home; leave a 3/4" nominal step between the ridge shingles and the roof shingles.

G. Soffit Vent
   1. Cut and remove the insulation board from the roof panel leaving the plywood board extend to the eave. Install the soffit vent by nailing into roof edge blocking.

3.4 INSTALLATION OF SHINGLES

A. General:
   1. Install in accordance with Manufacturer's installation instructions. Minimize breakage of shingles by avoiding dropping bundles on edge, by separating shingles carefully (not by "breaking" over ridge or bundles), and by taking extra precautions in temperatures below 40 degrees F.
   1. Handle carefully in hot weather to avoid scuffing the surfacing or damaging the shingle edges.
   2. Build-in flashings as shingle work progresses.
   3. Comply with instructions and recommendations of shingle manufacturer, except to extent more stringent requirements are indicated.
   4. Flashing: Install metal flashing as shown and in accordance with details and recommendations of the NRCA Steep Roofing Manual.

5. Eave Metal:
   a Install eave metal flashing before protective underlayment. Place eave metal flashings tight with fascia and roof sheathing. Weather lap joints 2 inches secure flange with nails spaced 4 inches on center.

6. Seal rake edge shingles to underlayment and drip edge with a four-inch-wide strip of roofing cement.

B. Placement and Nailing:

1. Beginning with the starter strip, trim shingles so that they "nest" within the shingle located beneath it. This procedure will yield a first course that is typically 3" to 4" rather than a fully exposed shingle.
2. For maximum wind resistance along rakes, install starter strip containing sealant or cement shingles to underlayment and each other in a 4" width of asphalt plastic roof cement.
3. Offset the new shingles from the existing keyways, to avoid waves or depressions caused by excessive dips in the roofing materials.
4. Using the bottom of the tab on existing shingles, align subsequent courses.
5. Secure with **6 nails per shingle**.
6. Consult the application instructions for proper nail placement.
7. Nails must be driven flush with the shingle surface. Do not overdrive or under drive the nails.
8. Consult the application instructions for the specified shingle offsets.

C. Penetrations
   1. All Penetrations are to be flashed according to ARMA and NRCA application instructions and construction details.

3.5 PROTECTION

A. Protect installed products from foot traffic until completion of the Project.
B. Any roof areas that are not completed by the end of the workday are to be protected from moisture and contaminants.
C. The roofing underlayment shall not be utilized as a temporary roof and shall be covered with the roof shingles within the same work day.

3.6 EXTRA STOCK

A. Provide minimum of 2% of installed quantity of each type/color/texture shingle used in the work. Provide in unopened clearly labeled bundles or containers.

END OF SECTION

SECTION 07 55 00
MODIFIED BITUMINOUS ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing system on wood deck and steel deck, including but not limited to:, including but not limited to:
   1. Roof insulation.
   2. Roof insulation cover board.
   3. SBS-modified bituminous membrane roofing.
   4. Granule-surfaced SBS-modified bituminous membrane cap sheet.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 "Standard Terminology Relating to Roofing and Waterproofing" and glossary in applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" for definition of terms related to roofing work in this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
B. Meet with DPMC, Building Management, Architect, Roof Monitor, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted elements.
C. The agenda will include the review of the methods and procedures related to roofing tear-off, including, but not limited to, the following:
   1. Review drawings and specifications.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
   7. Review governing regulations and requirements.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

D. This meeting shall be combined with the Preinstallation Meeting referenced in Section 07 01 50.

1.5 ACTION SUBMITTALS

A. Product Data: Complete product data sheets including sufficient data to show compliance with the Specification requirements for each type of product indicated in this Section. Include SDS sheets.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Provide roof plan showing orientation and type of roof cover board, tapered insulation, orientation of membrane roofing, and fastening spacings and patterns for mechanically fastened components.
   1. Base flashings and built-up terminations.
      a) Indicate details meet requirements of NRCA and FMG required by this Section.
   2. Tapered insulation, including slopes.
   3. Crickets, saddles, and tapered edge strips, including slopes.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements. Include FMG RoofNav report.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.
B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements, including FM Global system approval.
   2. Product Compatibility: Indicate manufacturer has verified compatibility of roofing system components, including but not limited to: Roofing membrane, flashing sheets, adhesives and sealants.

C. Warranties: Unexecuted sample copies of special warranties.
D. Field Quality Control Reports: Reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.
   1. Submit reports within 48 hours after inspection.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 01 78 23 for Closeout submittal requirements.

1.8 QUALITY ASSURANCE

A. Provide a roofing system that meets or exceeds all criteria listed in this section.
B. Installer shall be approved by the manufacturer to perform the specified roof installation and provide the manufacturers warrantee.
C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing manufacturer.
D. Roofing Manufacturer’s Inspections: Manufacturer’s Technical Representative shall provide at least two interim inspections during the roofing installation and a comprehensive final inspection after completion of the roof system. All application errors must be addressed, and final punch list completed.
E. The Contractor must include within the DPMC 12a - Unit Schedule Breakdown a line item for Manufacturer Inspections.
F. Installer shall be an employer of workers trained and certified by manufacturer, including a full-time on-site supervisor experienced in installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the Manufacturer to install manufacturer's product and furnish warranty of type specified.
   1. For torch-applied applications, employ workers certified under NRCA's Certified Roofing Torch Applicator (CERTA) program.

G. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's

compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer.
2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute, retained by the Contractor or the Manufacturer and approved by the Manufacturer.

H. Manufacturer's Installation Instructions: Obtain and maintain on-site access to manufacturer's written instructions for installation of products.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.
C. Store roll goods on end on pallets in a clean, dry, protected area. Take care to prevent damage to roll ends or edges. Do not double stack modified bitumen products.
D. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.
E. Remove manufacturer supplied plastic covers from materials provided with such. Use “breathable” type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material is to be installed.
F. Materials shall be stored above 55°F a minimum of 24 hours prior to application.
G. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
H. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
I. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck. Maximum 20 pounds per square foot.
J. Any products/materials that are not protected from the weather will be rejected and replaced at the Contractor’s expense.

1.10 PROJECT / FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
B. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
    1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed.
    2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
    3. Remove temporary plugs from roof drains at end of each day.
    4. Remove and discard temporary seals before beginning work on adjoining roofing.

1.11 REGULATORY REQUIREMENTS

A. All work shall be performed in a safe, professional manner, conforming to the International Building Code, (IBC) New Jersey Edition, 2021.

1.12 WARRANTIES

A. Manufacturer's Warranty: Roof System Manufacturer's standard form in which Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within warranty period, as follows.
   1. Form of Warranty: Manufacturer's standard warranty form.
   2. Scope of Warranty: Work of this Section and including sheet metal details and termination details installed by the roof system Installer and approved by the Roof System Manufacturer.
   3. The windspeed limitation shall not be less than the design windspeed listed on the Drawing Title Sheet.
   4. Warranty Period: 25 years from date of completion.

B. Roof Warrantees:
   1. Provide Manufacturer’s Guarantee with single source coverage and no monetary limitation, where the manufacturer agrees to repair or replace components in the roofing system, which cause a leak due to a failure in materials or workmanship for a period of twenty-five (25) years from the date of completion. The wind exclusion shall not be less than the design wind speed rating specified on the Drawing Title Sheet.
   2. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum. Inspections to occur in following years: 2, 5, 10, 15 and 20 following completion.
   3. Performance Agreement: The Contractor shall provide a five (5) year performance agreement on labor and material in addition to the manufacturer's warranty. The performance agreement shall include the stipulation that the Contractor shall perform all inspections and emergency repairs to all defects or leaks in the roofing system within 24 hours of receipt of notice from the owner. Repairs shall include all labor, roofing materials, flashings, etc. When weather permits, all temporary repairs shall be redone and the roof restored to the standard of the original installation.
   4. In the event that (a) the Owner notifies the Contractor of the need to correct a guaranteed condition, and (b) an emergency condition exists that requires immediate attention to prevent potential injury or damage, and (c) the Contractor cannot or does not promptly inspect and repair same, either permanently or temporarily, then the Owner may make, or cause to be made, such temporary repairs as may be essential and the Contractor shall reimburse the Owner for the cost of such repairs. Such action shall not relieve the Contractor of his obligation to perform any necessary permanent repairs and this Guarantee shall remain in full force and effect for the remaining portion of its original term.
   5. The Contractor shall provide all equipment, labor and material required to remedy any and all guaranteed conditions, including repair and/or replacement of damage to other work resulting therefrom, and removal and replacement of other work required to access the guaranteed condition, all at the Contractor’s sole expense for the full term of the Guarantee.
   6. The Contractor agrees to perform a thorough inspection of the roofing system and all other work, in the 12th and 24th months of the Guarantee period, in the presence of a manufacturer’s representative and an Owner’s representative. If there are any guaranteed conditions encountered at either, or both of these inspections, the Contractor shall make, or cause to be made, any necessary repairs and/or replacement to remedy the conditions under the terms of this Guarantee within thirty (30) days of the date of inspection or as otherwise agreed by the State of New Jersey even if such time extends beyond the guarantee period.
   7. The Contractor shall be responsible for inspections and emergency repairs to all defects and leaks in the roofing system during construction within four hours of receipt of notice from the Owner. Repairs shall include all labor, materials, flashings, etc. When weather permits, all temporary repairs shall be re-done and the roof restored to the standard of the original construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
   1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
   2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Roofing System Design: Provide roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency in accordance with ANSI/FM 4474, UL 580, or UL 1897, and to resist uplift pressures calculated in accordance with ASCE-7 and applicable code.
   1. All Zones (Corner, Perimeter, and Field-of-Roof) Uplift Pressures: As indicated on Drawings.

C. FM Global Compliance: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4470 as part of a roofing system and shall be listed in FM Global's "RoofNav" or shall receive written FM Global project approval for Class 1 or non-combustible construction, as applicable. Identify applicable materials with FM Global markings.
   1. Fire Classification:
      a) Internal Fire: Class 1
      b) Exterior Fire: Class A.
   2. Wind Uplift Rating: As required per Drawings.
   3. Hail Resistance Rating: MH.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1.

E. Flashings and Fastening: Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
   1. FM Global 1-49: Loss Prevention Data Sheet for Perimeter Flashings.
   2. FM Global 1-29: Loss Prevention Data Sheet for Above Deck Roof Components.
   3. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
   4. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
   5. Comply with requirements of Division 07 Section "Sheet Metal Flashing and Trim”.

F. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with the fire-resistance rated assembly designs indicated.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency
   2. Identify products with appropriate markings of applicable testing agency.

2.3 MATERIALS, GENERAL

A. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
B. FM Global Material Standards: Roofing, base flashings, and component materials shall be identical to materials that comply with requirements in FM Global 4470 as part of a roofing system listed or approved by FM Global. Identify applicable materials with FM Global markings.

2.4 ROOFING MEMBRANE MATERIALS

A. Sheathing Paper (Wood Decking): Red-Rosin type, minimum 3 lb/100sq.ft.
B. Base-Ply Sheet: SBS-modified asphalt coated composite polyester / fiberglass/fiberglass mat reinforced high tensile strength base sheet, ASTM D4601 Type II.
    1. Tensile Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 165 lbf/in (725 N); Cross machine direction, 150 lbf/in (660 N).
    2. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 260 lbf (1150 N); Cross machine direction, 230 lbf (1120 N).
    3. Thickness, minimum, ASTM D5147: 0.060 inch (1.5 mm).

C. SBS Modified Bituminous Membrane Ply Sheets: SBS-modified asphalt coated composite polyester / fiberglass/fiberglass mat reinforced high tensile strength base sheet, ASTM D4601 Type II.
    1. Tensile Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 165 lbf/in (725 N); Cross machine direction, 150 lbf/in (660 N).
    2. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 260 lbf (1150 N); Cross machine direction, 230 lbf (1120 N).
    3. Thickness, minimum, ASTM D5147: 0.060 inch (1.5 mm).

D. SBS Modified Bituminous Cap Sheet: SBS-modified asphalt-coated composite polyester and glass-fiber-reinforced high-tensile strength sheet, white granular surfaced; ASTM D6162 Grade G Type III.
    1. Exterior Fire-Test Exposure, ASTM E108: Class A.
        1. Tensile Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction 345 lbf/in (60 kN/m); Cross machine direction 340 lbf/in (60 kN/m).
        2. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 600 lbf (2.6 kN); Cross machine direction 580 lbf (2.5 kN).
        3. Elongation at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction 12 percent; Cross machine direction 8 percent.
        4. Low Temperature Flex, maximum, ASTM D5147: -40 deg. F.
        5. Thickness, minimum, ASTM D5147: 0.145 inch (3.7 mm).
        6. Solar Reflectance Index (SRI), ASTM E1980: 88.

E. Membrane Flashing Sheet: Flashing Sheet, Thermoset: Elastomeric polyester reinforced sheet with EPDM and SBR elastomers.
    1. Breaking Strength, minimum, ASTM D751: Machine direction 350 lbf; Cross machine direction 300 lbf.
    2. Tear Strength, minimum, ASTM D751: Machine direction 77 lbf; Cross machine direction 77 lbf.
    3. Elongation at Failure, minimum, ASTM D751: Machine direction 30 percent; Cross-machine direction 35 percent.
    4. Low Temperature Flexibility, minimum, ASTM D2136: -40 deg. F.
    5. Thickness, minimum, ASTM D751: 0.045 inch.
    6. Color: Black.

F. Flashing Backer Sheet: SBS-modified asphalt coated composite polyester / fiberglass/fiberglass mat reinforced high tensile strength base sheet, ASTM D4601 Type II.

1. Tensile Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 165 lbf/in (725 N); Cross machine direction, 150 lbf/in (660 N).
2. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 260 lbf (1150 N); Cross machine direction, 230 lbf (1120 N).
3. Thickness, minimum, ASTM D5147: 0.060 inch (1.5 mm)

G. Flashing Sheet: SBS/SEBS-modified asphalt-coated composite polyester and glass-fiber-reinforced sheet, granular surfaced, ASTM D6162 Type III Grade G.
1. Exterior Fire-Test Exposure, ASTM E108: Class A.
2. Tensile Strength at 73 deg. F (23 deg. C), minimum, ASTM D5147: Machine direction 345 lbf/in (60 kN/m); Cross machine direction 340 lbf/in (60 kN/m).
3. Tear Strength at 73 deg. F (23 deg. C), minimum, ASTM D5147: Machine direction, 600 lbf (2.6 kN); Cross machine direction 580 lbf (2.5 kN).
4. Elongation at 73 deg. F (23 deg. C), minimum, ASTM D5147: Machine direction 12 percent; Cross machine direction 8 percent.
5. Low Temperature Flex, maximum, ASTM D5147: -35 deg. F (-37 deg. C).
6. Thickness, minimum, ASTM D5147: 0.138 inch (3.5 mm).

H. Detailing Fabric: Woven Glass Fiber Mesh, Vinyl-Coated: Non-shrinking, non-rotting, vinyl-coated woven glass mesh for reinforcing flashing seams, membrane laps, and other roof system detailing.
1. Tensile strength, 70 deg. F, min ASTM D146: Warp, 65 lbf/in; fill, 75 lbf/in.

2.5 COLD-APPLIED ADHESIVE MATERIALS

A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Plastic Foam Adhesives: 50 g/L.
2. Gypsum Board and Panel Adhesives: 50 g/L.
3. Other Adhesives: 250 g/L.
4. Nonmembrane Roof Sealants: 300 g/L.
5. Sealant Primers for Nonporous Substrates: 250 g/L.
6. Sealant Primers for Porous Substrates: 775 g/L.

B. Modified Bituminous Base-Ply, Interply and Cap Sheet Adhesive:
1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BioPreferred, formulated for compatibility and use with specified roofing membranes and flashings.
1. Volatile Organic Compounds (VOC), maximum, ASTM D3690: 0 g/L.
2. Low Temperature Flexibility, ASTM D2240: Pass at -30 deg F.
3. Solids, by volume, ASTM D2697: 100%
4. BioBase Content, Minimum, ASTM D6866: 70%

C. Flashing Sheet Adhesive: and Flashing Backer:
1. Roofing Mastic, Modified Asphalt, Brush-Grade: One-part, SBS modified, cold-applied mastic specially formulated for compatibility and use with specified roofing membranes and flashings.
1. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 222 g/L.
2. Viscosity at 77 deg. F (25 deg. C), ASTM D2916: 260,000 cP
3. Density at 77 deg. F (25 deg. C), ASTM D1475: 8.2 lb/gal.
4. Lap Shear Adhesion at 77 deg. F. (Minimum ASTM D146): 77lbf

D. Asphalt Primer:
   1. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 2 g/L.
   2. Flash Point, minimum, ASTM D3278: 100 deg. F.
   3. Non-Volatile Content, ASTM D1644 : 52 percent.

E. Asphalt Roofing Cement: ASTM D4586, Type II, Class I, fibrated roof cement formulated for use in installation and repair of asphalt ply and modified bitumen roofing plies and flashings; UL-classified for fire resistance.
   1. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 190 g/L.
   2. Non-Volatile Matter, ASTM D4586: 85 percent.
   3. Resistance to sag ASTM D4586: 1/8 in.

2.5 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
B. Cold-Applied Flashing Adhesive: SEBS/SIS modified asphalt, for elastomeric flashing membranes.
   1. VOC, maximum, ASTM D3960: 250 g/L.
   2. Adhesion in peel, minimum, ASTM D1876: 3 lbf/in.
   3. Lap shear adhesion, minimum, ASTM D816: 18 psi.
   4. Color: Black.

C. Stripping Adhesive / Sealer:
   1. Seam Sealer: Aromatic polyurethane sealer, single-component, high solids, moisture curing, formulated for compatibility and use with a variety of roofing and flashing Substrates.
      1. VOC, Maximum, ASTM D3960: 189 g/l/
      2. Tensile Strength, ASTM D412: 270psi
      3. Tear Strength, ASTM D412: 35pli
      4. Elongation, ASTM D412: 220%
      5. Color: Gray

D. Polyester Reinforcing and Protection Fabric: 100 percent stitch-bonded mildew-resistant polyester fabric intended for reinforcement of compatible fluid-applied membranes and flashings and as a protection layer under pavers or stone aggregates.
E. Roofing Joint Sealant: Elastomeric joint sealant compatible with roofing materials, with movement capability appropriate for application; ASTM C920, Type S, Grade NS, Class 50 single-component moisture curing sealant, formulated for compatibility and use in dynamic and static joints; paintable.
   1. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 40 g/L.
   2. Hardness, Shore A, ASTM C661: 40.
   3. Tensile Strength, ASTM D412: 350 psi.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Global 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.
H. Plumbing Vents: Plumbing vent penetrations shall be extended and flashed with lead flashing rolled down 2" into the vent pipe, as detailed on the drawings.
I. Retrofit Roof Drains: Retrofit Roof Drains shall be 4" diameter replacement roof drains designed to penetrate the original roof drain body, bonding securely to the inside of the drain pipe. Drain shall be spun aluminum .064" with SBS Smooth flashing flange. Provide cast aluminum gravel guard and strainer and Emseal expanding seal. Retrofit drains shall be approved for use in the roofing system by the Roofing Manufacturer.
J. Roofing Nails: Type 304 or Type 316 Stainless Steel.

2.6 ROOF INSULATION MATERIALS

A. Roof Insulation, General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
   1. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, not less than two times the roof slope.

B. Roof Insulation:
   1. Existing insulation that is not wet or damaged is to be retained in place and re-utilized.
   2. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.
      a) Compressive Strength, ASTM D1621: Grade 2: 20 psi.
      b) Conditioned Thermal Resistance at 75 deg. F: 14.4 at 2.5 inches thick.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated. Tapered insulation for crickets shall be 1/2” per foot slope (1:24).

2.7 INSULATION ACCESSORIES

A. Roof Insulation Cover Board:
   1. Gypsum panel, cellulosic fiber reinforced, water-resistant ASTM C1278/C1278M.
      a) Thickness: 1/2 inch.

B. Roof Insulation Adhesive:
   1. Urethane adhesive, bead-applied, low-rise two-component solvent-free low odor, formulated to adhere roof insulation to substrate.
      a) Flame Spread Index, ASTM E84: 10.
      b) Smoke Developed Index, ASTM E84: 30.
      c) Volatile Organic Compounds (VOC), maximum, ASTM D3960: 0 g/L.
      d) Tensile Strength, minimum, ASTM D412: 250 psi.
      e) Peel Adhesion, minimum, ASTM D903: 17 lbf/in.
      f) Flexibility, 70 deg. F, ASTM D816: Pass.

C. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
D. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
E. Substrate Joint Tape: Minimum 6 inch wide, coated, glass-fiber joint tape.
F. Insulation Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

2.8 SURFACING MATERIALS

A. Acrylic Emulsion Flashing Coating Material:

   A. Acrylic Coating: Highly-reflective water-based low-odor and low-VOC semi-gloss coating formulated with flouropolymer resin for use as a finish coat over water-based acrylic roof and wall coatings and other approved substrates.
      a. Basis of design product: Tremco, T24 Coating.
      b. Volatile Organic Content (VOC) maximum, ASTM D3960: 50 g/L.
      c. Gloss at 60 deg, (white) ASTM D523: 60 percent.
      d. Solar Reflectance, ASTM C1549: 88 percent initial; 82 percent 3-year aged.
      e. Thermal Emittance: 0.89 initial; 0.86 3-year aged.
      f. Solar Reflectance Index (SRI), ASTM E1980: 111 initial; 102 3-year aged.
      g. Minimum Thickness: 12 mils (0.30 mm) wet per coat for each of two coats.

B. Primer for Acrylic Coatings: Acrylic polymer primer to promote adhesion of acrylic emulsion coatings on single-ply membranes.
   a. Basis of design product: Tremco, Tremco SP Primer.
   b. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 80 g/L.
   c. Solids, by Volume, ASTM D5201: 30 percent.
   d. Color: White dries clear.
   e. Nonvolatile content ASTM D1644: 32 percent (by weight).

2.9 WALKWAYS

A. Walkway Material: Walkway pads, ceramic-granule-surfaced reinforced asphaltic composition slip-resisting pads, manufactured as a traffic pad for foot traffic, 1/2 inch thick minimum.
   1. Flexural Strength at max. load, minimum, ASTM C203: 218 psi.
   2. Granule adhesion (weight loss), maximum, ASTM D4977: 1.1 gram.
   3. Impact Resistance at 77 deg. F, ASTM D3746: No Damage to Roof.
   4. Pad Size: 36 by 48 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
   2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Existing Prepared Roof Substrate: Verify that insulation and substrate is sound and dry. Refer to requirements of Division 07 Section "Preparation for Re-Roofing."
   4. Wood Roof Deck: Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
   5. Verify that insulation and substrate is sound and dry.
   6. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION, GENERAL

A. Install roofing system in accordance with manufacturer’s written instructions, approved shop drawings, and Contract Documents.
B. Install wood cants, blocking, curbs, and nailers in accordance with requirements of Division 06 Section "Miscellaneous Rough Carpentry."
C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing
D. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition.

3.4 ROOFING INSTALLATION DETAILS

A. FM Installation Details: Install roofing membrane, base flashings, wood cants, blocking, curbs and nailers and component materials in compliance with requirements in FMG 4470 as part of a membrane roofing system as listed in FMG's "Approval Guide" for fire/windstorm classification indicated. Comply with recommendations in FMG Loss Prevention Data Sheet 1-49. Choose only one of the following two NRCA Installation Details paragraphs. The first is a short version of the second.
B. NRCA Installation Details: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations; modify as required to comply with manufacturer's approved details and perimeter fastening requirements of FM Global references if applicable.

3.5 BASE SHEET INSTALLATION

A. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches respectively.

3.6 INSULATION INSTALLATION

A. Comply with roofing manufacturer's written instructions for installing roof insulation.
B. Coordinate installing membrane roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday
C. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of built-up roofing with vertical surfaces or angle changes greater than 45 degrees.
D. Tapered Insulation and Crickets: Install tapered insulation under area of roofing to conform to slopes indicated.
   1. Where crickets are indicated or required to provide positive slope to drain, make slope of crickets minimum of two times the roof slope, not less than 1/4 inch in 12 inches (1:48).

E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations. Insulation manufacturers usually recommend thickness in first paragraph below as maximum thickness of a single insulation layer. Edit paragraphs below to establish thickness of insulation required by code and project conditions. Coordinate with drawings. Consider using actual thickness in lieu of R-value/RSI to avoid disputes based upon alternate methods of calculating thermal resistance of insulation. (The base layer of insulation is the first, single, board layer, not the total flat-stock layer(s).) The minimum thickness of the base layer is often dictated by the wind uplift tested assembly; refer to applicable test report. R-Value is an imperial system unit of measurement (ft2·°F·h/BTU) and the RSI Value is a metric system unit of measurement (sq. m.·K/W). To convert an R-Value to an RSI Value, divide the R-Value by 5.678. Conversely, to convert an RSI Value to an R-Value, multiply the RSI Value by 5.678.

   1. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction. Flat Insulation System on Sloped Roof Deck: Install insulation at minimum thickness as follows:
      a. Minimum total thickness of Continuous Insulation: 5.2 inches.
   2. Tapered Insulation System for Flat Roof Deck: Install insulation as follows:
      b. Minimum total thickness of Continuous Insulation: 5.2 inches.

F. Insulation drain sumps are allowed to taper down to a thickness of not less than 1 inch less than the thickness required to achieve the continuous insulation thickness required by code. The size of the sump is further dictated by the slope. For example: A 1-inch deep sump at 1/4 inch per foot (1:48) slope would have a size of 4 ft. by 4 ft. To accommodate larger and/or deeper sumps, increase total insulation thickness as necessary.
   1. Insulation Drain Sumps: Tapered insulation sumps, not less than 2 by 2 ft., sloped to roof drain; sump to maximum depth of not more than 1 inch less than the Project-stipulated continuous insulation thickness based upon code requirements.

G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
I. Mechanically Fastened and Adhered Insulation Application Method: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
    1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.

J. Low-Rise Foam and Fas-N-Free are applied in ribbons.
    1. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    2. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.

L. Low-Rise Foam and Fas-N-Free are applied in ribbons.
    1. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining cover in place.

3.7 COLD-APPLIED ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in NRCA's "Quality Control and Quality-assurance Guidelines for the Application of Membrane Roofing" and as follows:
B. Base-Ply Sheet is the first ply in the roof membrane (when different than other ply sheets). Installation of Base Sheet installed on the deck, under insulation is specified elsewhere.
    1. Base-Ply Sheet: One.
        a. Adhering Method: Cold-adhesive applied.

2. Number of Smooth-Surfaced SBS-Modified Asphalt Sheets: One.
   b. Adhering Method: Cold-adhesive applied.

3. Granular-Surfaced SBS-Modified Asphalt Cap Sheet:
   c. Adhering Method: Cold-adhesive applied.

C. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
D. Cooperate with testing agencies engaged or required to perform services for installing roofing system.
E. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
   1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in compatible roofing cement/mastic, with joints and edges sealed.
      a. Comply with roofing membrane manufacturer’s instructions and details for waterstop/daily tie-in; utilize staggered layout and unadhered, removable “deadman” insulation boards.

   2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
   3. Remove temporary plugs from roof drains at end of each day.
   4. Remove and discard temporary seals before beginning work on adjoining roofing.

F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.8 BASE-PLY SHEET INSTALLATION

A. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches (50 mm and 150 mm), respectively.

3.9 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing membrane base-ply sheet, ply sheet(s) and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
   1. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.
   2. Embed each sheet in cold-applied membrane adhesive applied at rate required by roofing manufacturer.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Install roofing membrane sheets so side and end laps shed water. Completely bond and seal laps, leaving no voids.
   1. Repair tears and voids in laps and lapped seams not completely sealed.
   2. Granular Cap Sheet Laps: Apply roofing granules to cover exuded bead at laps.

3.10 HEAT-WELDING CAP SHEET SEAMS

A. Cap Sheet Seam Heat-Welding: Prepare and weld seams according to roofing manufacturer's written instructions.
   1. Clean minimum 4 inch (102 mm) wide seam area on both surfaces to be joined. Remove debris and contaminants. Allow seam to thoroughly dry prior to performing welding.
   2. Continuously weld 4 inch (102 mm) wide seam using roofing manufacturer's recommended automatic heat welding machine or hand-held heat gun. Roll seam with minimum 75 lb. (34 kg) steel roller.

3.11 FLASHING AND STRIPPING INSTALLATION

A. Base Flashing Installation, General: Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:
   1. Extend base flashing up walls or parapets a minimum of 12 inches above modified bituminous roofing and 6 inches onto field of built-up roofing.
   2. Prime substrates with primer if required by roofing system manufacturer.

B. Flashing Sheet Installation: Adhere flashing sheet to substrate in cold-applied adhesive. Apply cold-applied flashing sheet adhesive to back of flashing sheet if recommended by roofing manufacturer.
   1. Flashing Sheet Top Termination: Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
      a. Seal top termination of base flashing with a metal termination bar and a continuous bead of joint sealant.
   2. Flashing Sheet Bottom Termination: Adhere flashing sheet to roofing membrane in continuous bed of cold-applied adhesive.
      b. Elastomeric Flashing Sheet: Heat weld vertical flashing joints. Seal bottom termination of base flashing by adhering to roofing membrane with cold-applied adhesive and sealing flashing-to-membrane joint with joint sealant.

C. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

D. Install stripping, according to roofing manufacturer's written instructions, where metal flanges and edgings are set on modified bituminous membrane roofing.

E. Flashing-Sheet Stripping: Install flashing-sheet stripping in a continuous coating of compatible mastic/adhesive sealer, as recommended by roofing manufacturer, and extend onto roofing membrane. Apply number of courses recommended by manufacturer.

F. Roof Drains: Set 30 by 30-inch square metal flashing in bed of compatible mastic/adhesive sealer on completed roofing membrane. Cover metal flashing with roofing membrane cap sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
   1. Install stripping according to roofing system manufacturer's written instructions.

3.12 SURFACING AND COATING INSTALLATION

A. Acrylic Emulsion Coating:
   1. Prime surfaces as recommended by manufacturer.
   2. Apply acrylic emulsion coating to prepared base flashings, with number of coats, thickness of application, and application method as recommended in writing by coating manufacturer.

3.13 WALKWAY INSTALLATION

A. Walkways, General: Install walkways according to roofing manufacturer's written instructions.
   1. Install walkways at following locations:
      a. Where indicated on Drawings.

B. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
   1. Sweep away loose aggregate surfacing.
   2. Set walkway pads in manufacturer's recommended, compatible adhesive.

3.14 FIELD QUALITY CONTROL

A. Roofing Inspector: Contractor will engage a qualified roofing inspector to perform roof tests and inspections and to prepare test reports.

1. Engage a qualified roofing inspector for a minimum of 5 full-time days on site, per 40-hour crew week, to perform roof tests and inspections and to prepare start up, interim and final reports. Roofing Inspector's quality assurance inspections shall comply with criteria established in NRCA's "Quality Control and Quality-assurance Guidelines for the Application of Membrane Roofing Systems."

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation at commencement and upon completion.
   1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of built-up roofing where test results or inspections indicate that they do not comply with specified requirements.
   1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.15 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Scope: The work under this Section includes the supply and installation of roof edge flashings and window head flashing as detailed on the drawings and specified herein.

1.3 RELATED WORK

A. The following related work is specified in other sections:
   1. Section 06 65 00 - Simulated Wood Trim
   2. Section 07 55 00 - Modified Bituminous Roof
   3. Section 07 92 00 - Joint Sealers

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, installation instructions and general recommendations for each specified sheet material and fabricated product.
B. Samples: Submit a 12" square samples of specified sheet materials to be utilized, for approval.
C. Shop Drawings: Submit shop drawings showing layout, joining, profiles, and anchorages of fabricated work, including flashing, counter flashing, trim, fascia, expansion joint details and layouts at 1/4" scale with details at 3" scale.

1.5 JOB CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protect of materials and finishes.

1.6 REFERENCES

A. ASTM - Listed Standards
B. SMACNA - Architectural Sheet Metal Manual
C. NRCA – Roofing and Waterproofing Manual

PART 2 – PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Material: Stainless Steel ASTM A167, Type 304. Provide flashing in accordance with the Table I.
B. Aluminum: 3005-H25 Aluminum thickness as noted.
C. Aluminum trim shall have the exterior side finished with an extended life, fluoropolymer coating utilizing Kynar 500 Resin. Surfaces shall be properly prepared and primed, then coated and oven-baked to cure. Top coating system shall have a dry film thickness of 0.75 - .90 mils on the exterior surface. Specular Gloss at 60º viewing angle shall be 35 ± 5%. The interior side of these panels shall be protected by a back coat system of .60± .05 mils thickness. Panels shall be coated prior to roll forming.
D. Furnish sheet metal items in 8 to 10-foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Provide accessories and other items essential

to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this Section.

E. Soldering Flux: ASTM B284, Rosin or 0-F506 where necessary.
F. Solder: ASTM B32
G. Bituminous Plastic Cement: ASTM D4586, Type I
H. Asphalt Primer: ASTM D41

2.2 FABRICATED UNITS

A. General Metal Fabrication: 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. Comply with material manufacturer instructions and recommendations. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
B. Joining: Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.
C. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).
D. Separations: Insulate between dissimilar metals with one of the following bituminous paint, one coat primer, and one coat aluminum paint, caulking compound bituminous plastic cement, asphalt, varnish or approved non-absorptive tape or gasket. Resistance across insulated finish joint shall exceed 55,000 ohms.
E. The bottom edge of all exterior exposed flashings shall be hemmed.

PART 3 – EXECUTION

3.1 JOINTING

A. Expansion and Contraction: Provide expansion and contraction joints at not more than 32-foot intervals for aluminum and at not more than 40-foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum edge flashings and fascia by expansion and contraction joints spaced not more than 12 feet apart.
B. Soldering:
    1. Where soldering is specified, it shall apply to stainless steel, and zinc-coated steel. Pre-tin edges of sheet metals before soldering. Slowly solder with well-heated soldering items so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux, the edges of stainless steel to be pre-tinned. Solder immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water.

C. Lock seam Joints: Fabricate sheet metal with either single or double lock seam flat-lock seams.
D. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.

3.2 FLASHING INSTALLATION

A. Requirements: Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections, which might affect the application. For installation of items not shown in detail or not covered by specifications, conform to the applicable requirements of SMACNA ASMM, Architectural Sheet Metal Manual. Provide sheet metal flashings in the angles formed where roof decks abut walls, curbs, ventilators, pipes or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.
B. Workmanship: Make lines, arises, and angles sharp and true. Free exposed surfaces from visible wave, warp and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2-inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.
C. Nailing: Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing or flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2-inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.
D. Bolts, Rivets, and Screws: Install bolts, rivets, and screws where indicated or required.
E. Provide compatible washers where required to protect surface of sheet metal and to provide a water-tight connection.

3.3 CLEANING AND PROTECTION

A. Cleaning: Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.
B. Protection: Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering, at time of substantial completion.

TABLE I
SHEET METAL WEIGHTS THICKNESS AND GAUGES

FLASHING	MATERIAL	THICKNESS AND GAUGES	NOTES
Eave & Rake Flashing	Aluminum	.032	
Counter Flashing	Aluminum	.040	
Edge Flashing	Aluminum	.032	
Pipe Vent	Aluminum/neoprene	.040	
Head Flashings	Aluminum	.032	

TABLE II
SHEET METAL JOINTS

All	2” lap joints with plastic cement between edge flashing.

END OF SECTION

SECTION 07 71 00
METAL COPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes prefinished metal coping.
B. Scope: Furnishing and installing factory fabricated and finished coping on existing walls.
C. Related Sections:
   1. Section 06 11 41 - Wood Nailers, Cants, and Blocking
   2. Section 07 92 00 - Joint Sealers

1.3 REFERENCES

A. Factory Mutual Research Corporation (FMRC), P.O. Box 9102, Norwood, MA 02082, 617-762-4300.
B. SPRI Sheet Membrane and Component Suppliers to the Commercial Roofing Industry, 175 Highland Ave., Needham, MA 02194, 617-444-0242, fax: 617-444-6111.

1.4 SUBMITTALS

A. Product Data: Provide manufacturer's product and complete installation data for all materials in this specification. Include manufacturer's written installation guide.
B. Shop Drawings: Show profiles, joining method, accessories location, anchorage, and flashing details, adjacent construction interface, and dimensions.

1.5 QUALITY ASSURANCE

A. High performance coping shall be CERTIFIED by the coping manufacturer to meet performance design criteria according to the following test standards:
   1. SPRI Test RE-3 for Coping: Wind Design Guide for Edge Systems Used with Low Slope Roofing Systems (current edition). The coping system shall be tested simultaneously on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as calculated in accordance with the SPRI Test RE-3.
   2. FMRC Loss Prevention Data Sheet 1-49 "Perimeter Flashing": The coping product shall be listed in current Factory Mutual Research Corporation Approval Guide approved for Zone 2, 90 PSF uplift.
   3. Edges: Pre-tin edges of sheet metals before soldering. Slowly solder with well-heated soldering items so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux, the edges of stainless steel to be pre-tinned. Solder immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered in the manufacturer's original sealed, labeled containers.
B. Store materials in a dry, protected, well-vented area. The Contractor shall report damaged material immediately to the delivering carrier and note such damage on the carrier's freight bill of lading.
C. Remove protective plastic surface film immediately after installation.

1.7 PROJECT CONDITIONS

A. Verify that other trades with related work are complete before mounting coping covers.
B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

1.8 WARRANTY

A. Manufacturer's Standard Warranty: Materials shall be free of defects in material and workmanship for five (5) years after shipment. If, after inspection, the manufacturer agrees that materials supplied by them are defective, the manufacturer shall at their option repair or replace them. Decorative finishes are not included under the Manufacturer's Standard Warranty.

PART 2 – PRODUCTS

2.1 PARAPET COPING SYSTEM

A. Coping: Metal coping cap with continuous galvanized steel anchor cleats for capping any parapet wall. The system shall be watertight, maintenance free, and not require exposed fasteners or sealant. Joints shall be butt type with concealed splice plates.
B. Performance characteristics:
    1. Coping sections shall expand and contract freely while mechanically locked in place on anchor cleats.
    2. Coping sections shall lock to anchor cleats by mechanical pressure from support chairs.
    3. All coping cover joints shall be underlayed with gutter/support chairs capable of draining water.

C. Metal: 050" aluminum prefinished with Kynar-500 coating in white.
D. Coping Cap: Minimum lengths of 10'-0"; width as required to cover existing parapet. Refer to drawings for approximate widths.
E. Coping Vertical Face and Back Leg: Custom size as detailed on drawings.
F. Internal splice plates: Shall be concealed with matching finish to maintain outside face continuity.
G. Coping Cleat: Continuous 20-gauge galvanized steel anchor cleat to be mechanically fastened as indicated and as required by manufacturer.
H. Fasteners: Shall be screw type with a minimum pullout resistance of 275 lbs supplied by the installer as recommended by the manufacturer per substrate application. No exposed fasteners shall be permitted. Fasteners shall be electrolytically compatible. Contractor to load test anchors at each parapet to two (2) times the allowable pull-out force of 275 lbs (550 lbs total).

2.2 ACCESSORIES:

A. Corners, end caps, pier caps, cricket sections, etc. shall be fabricated by the coping manufacturer. Factory fabricated, mitered corners shall have nominal 24" leg lengths.
B. Welded or Metal-Lock assembly shall be used to maintain watertight integrity.

PART 3 – EXECUTION

3.1 INSPECTION

A. Verify that coping installation will not disrupt other trades. Verify that substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

A. Submit product design drawings for review and approval to Architect before fabrication.
B. Installing contractor shall check as-built conditions and verify the manufacturer's coping details for accuracy to fit the wall assembly prior to fabrication. The installer shall comply with the coping manufacturer's installation guide when setting copings.
C. Installer shall furnish mechanical fasteners with minimum 275 lbs. pullout resistance consistent with manufacturer's instructions; threaded and suitable for parapet substrates.

END OF SECTION

SECTION 07 71 23
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Scope: The work under this Section includes the supply and installation of gutters and downspouts (leaders) and accessories.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 61 00.
B. Manufacturer's data sheets on each product to be used, including preparation instructions and recommendations, storage and handling requirements and recommendations, and installation methods.

1.4 RELATED WORK

A. The following related work is specified in other sections:
   1. Flashing and Sheet Metal Trim - Section 07 62 00
   2. Joint Sealers - Section 07 92 00

1.5 JOB CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protect of materials and finishes.

1.6 REFERENCES

A. Fabricate and install gutters in accordance with Architectural Sheet Metal Manual, published by SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

PART 2 – PRODUCTS

2.1 PREFINISHED ALUMINUM GUTTERS

A. Gutters: Aluminum Gutters shall be rectangular box style, sizes as shown on the drawings. Gutters shall be fabricated from .032” prefinished aluminum. Gutters shall be fabricated to the maximum length practicable to eliminate field seaming.
B. Provide a SMACNA Detail 1-5E expansion joint ½” wide at a maximum of 50’ on center.
C. Gutter brackets: Fabricated from 1/8” x 1 1/2”, stainless steel. Brackets shall be spaced at a maximum 36” on center. Bracket vertical legs shall accommodate a gutter slope of 16” per foot.
D. Gutter Straps: Fabricated from 1/8” x 1 1/2” stainless steel. Straps shall be spaced at a maximum 36” on center.
E. Reinforcing Bar: 1/8” x 1” type 304 stainless steel.
F. Outlet tubes shall be formed from .032 aluminum with locked and soldered longitudinal seam. Upper end of tube shall be flanged ½” and soldered to gutter. Tube shall extend into downspout.
G. End Baffles, Strainers and Outlet Tubes: Baffles and outlet tubes shall be set in mastic and riveted. Strainers shall be provided at all outlet tubes. They shall be wire basket type stainless steel or galvanized steel.

H. Downspouts: Plain rectangular style fabricated from prefinished .032" aluminum.
I. Finishes: Gutters, downspouts, and accessories shall have the exterior side finished with an extended life, fluoropolymer coating utilizing Kynar 500® Resin. This coating shall be applied over aluminum substrate. Surfaces shall be properly prepared and primed, then coated and oven-baked to cure. Top coating system shall have a dry film thickness of 0.75 - .90 mils on the exterior surface. The interior side of these shall be protected by a back coat system of .60 ± .05 mils thickness.
J. Elbows: Style "A" Same gauge and material as downspouts.
K. Transitions: Schedule 40 PVC transition with cleanout from rectilinear downspout to HDPE underground pipe.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES:

A. Solder: For use with aluminum or copper, provide 50 – 50 (60-40 for lead coated copper) tin/lead solder (ASTM B 32), with rosin flux.
B. Fasteners: Same metal as flashing/sheet metal or, other non-corrosive metal as recommended by sheet manufacturer. Match finish or exposed heads with material being fastened.
C. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gage required for performance.
D. Splash Blocks: Cast concrete, to be provided at the base of every downspout (leader) where indicated.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General: Except as otherwise indicated, comply with SMACNA "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams which will be permanently watertight and weatherproof.
B. Gutter Positioning: Position gutter so the outer edge of the highest point of the gutter is below the roof line projection. Slope gutters towards downspouts from high point between downspouts unless otherwise specified on the drawings.
C. Gutters: Install gutters at 1/16" per foot sloped to drain, unless otherwise shown on the drawings.
D. Brackets and straps shall be securely anchored in a manner that will not prevent the entry of water into gutter.
E. Brackets and straps shall be installed at 36" on center maximum and shall be fastened to the substructure.
F. Downspout supports shall be installed at 48' on center and at 5 foot on center for cross pipes. Attach brackets to building structure using appropriate fasteners.
G. Connect leaders to underground drainage system inlets utilizing the transitions specified above. Cleanouts shall be provided at all connections to underground drainage system. Downspouts terminating above grade shall have 45-degree elbows discharging onto new concrete splash blocks.
H. End Baffles shall be soldered.

3.2 CLEANING AND PROTECTION

A. Cleaning: Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.
B. Protection: Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering, at time of substantial completion.

END OF SECTION

SECTION 07 84 00
PENETRATION FIRESTOPPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General Conditions, Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Firestopping for the following:
   1. Penetrations through partitions including both empty openings and openings containing pipes and conduits.

B. Related Work:

   1. Sealants required or specified in other sections.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide firestopping systems produced and installed to resist the spread of fire and the passage of smoke and other gasses in compliance with Code
B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their “Fire Resistance Directory” that is updated annually with a midyear supplement.
   1. UL Fire Resistance Directory
      a. Through-Penetration Fire Stop Devices (XHCR)
      b. Fire Resistance Rating (BXUV)
      c. Through-Penetration Fire Stop Systems (XHEZ)
      d. Fill Voids or Cavity Material (XHHW)
      e. Forming Materials (XHKU)

C. Test Requirements: UL 2079, “Tests for Resistance of Building Joint Systems”

1.4 SUBMITTALS

A. Data: Manufacturer product data for all materials and prefabricated devices and manufacturer’s installation instructions.
B. Certification: Letter of certification, or certified laboratory test report that the material or combination of materials proposed for use meets the requirements specified in ASTM E 814, are so classified in UL Building Materials Directory, and are approved by the Building Department.
C. Evaluation Reports: Evidence of fire resistive joint systems’ compliance with ICC Evaluation Service
D. Documentation:
   1. Include illustrations, from a qualified testing and inspecting agency, applicable to each through penetration firestop configuration for construction and penetrating items.
   2. Where Project conditions require modification of qualified testing and inspecting agency illustration to suit a particular through penetration firestop condition, obtain Authoritative Agency acceptance of the modification prior to submitting shop drawings.

1.5 QUALITY ASSURANCE

A. Single source responsibility: Obtain through penetration firestop systems for each kind of penetration and construction condition indicated, from a single manufacturer.
B. Compatibility: Provide firestop systems compatible with one another and with substrates under conditions of application and service.
C. A manufacturer's direct representative (not distributor or agent) to be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
D. Firestop system installation, must meet requirements of ASTM E 814, UL 14S pr I: 2-80 tested assemblies that provide a fire rating equal to that of construction being penetrated.
E. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by The International Firestop Council.

1.6 HANDLING

A. Storage: Store and handle materials to prevent their deterioration or damage. Do not use damaged and contaminated materials.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of one or a combination of the following, as required by condition of use:
    1. Hilti Construction Chemicals, Inc.
    2. DAP Products Inc.
    3. 3M Fire Protection Products
    4. Or Approved Equal

2.2 MATERIALS

A. All through penetrations shall be labeled on both sides of the wall to indicate the appropriate UL system number, product used, installation date, hour rating installer, location number and telephone contact for the corresponding manufacturer. Material installed shall be as required for installation conditions and to achieve the required fire resistance.
B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
    1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Use only firestop products that have been UL 1479, ASTM E-814, or UL2079 tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annual space requirements, and fire rating involved for each separate instance.
D. For penetrations by non combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:
    1. Hilti FS 601 Elastomeric Firestop Sealant
    2. Hilti FS ONE High Performance Intumescent Firestop Sealant
    3. 3M Fire Stop Sealant 2000 4. 3M Fire Barrier CP25 WB
    4. DAP Fire Stop Silicone Sealant
    5. Or Approved Equal

E. For penetrations by combustible plastic pipe (open piping systems), the following materials are acceptable:
    1. Hilti CP642 Firestop Jacket
    2. Hilti CP 643 Firestop Jacket
    3. Hilti FS ONE High Performance Intumescent Firestop Sealant
    4. 3M Fire Barrier PPO Plastic Pipe Device
    5. DAP Blockade High Performance Intumescent Sealant
    6. Or Approved Equal

PART 3 – EXECUTION

3.1 PREPARATION

A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.2 INSTALLATION

A. Install materials in compliance with their manufacturer's instructions and the printed instructions of UL Fire Resistance Directory.
B. Masking:
    1. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed and that would be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials.
    2. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 CLEANING

A. Clean-up spills of liquid components.
B. Cut and trim excess materials neatly, flush with adjacent surfaces.

END OF SECTION

SECTION 07 92 00
JOINT SEALERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the provision and installation of sealants and backing rods.
B. Scope: Provide all materials, labor, equipment, and appliances required to complete work of this Section, including, but not necessarily limited to, the following:
   1. Preformed, pre-compressed, expanding foam joint seals for expansion joints in exterior walls.
   2. Replacement of existing and installation of new joint sealant
   3. Cleaning and priming of joints as required by Manufacturer's installation instructions.
   4. Installation of sealants and backer rods.

1.3 REFERENCES

A. ASTM C 321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
C. FS (Federal Specification) TT-S-00227E (COM-NBS) - Interim Federal Specification for Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures.
D. FS (Federal Specification) TT-S-00230C - Interim Federal Specification for Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures.
E. FS (Federal Specification) TT-S-001543 (COM-NBS) - Interim Federal Specification for Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures.

1.4 QUALITY ASSURANCE

A. Performance: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.
B. Pre-Installation Compatibility and Adhesion Tests: Contractor shall be responsible for verifying with sealant manufacturer that all sealants to be used are compatible with and will satisfactorily adhere to all substrates. Tests shall be conducted in the field and witnessed by the Architect or Inspection Agency.
C. Adhesion Test: During installation, in the presence of, and when and where directed by the Architect or Inspection Agency, conduct pull test on each joint type. Test is to be performed by slicing across the joint and then cutting both sides of the joint two inches, separating the sealant from the adjoining material. The sealant shall then be pulled in the direction of the joint. The sealant should break rather than separate from the adjoining material.

1.5 SUBMITTALS

A. Submit under provisions of Division 1.
B. Manufacturer's Technical Data, Guides, and Application Procedures
C. Submit physical samples illustrating colors.
D. Submit laboratory tests, or data, validating product compliance with performance criteria specified.
E. Submit a copy of the Manufacturer's warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Material Safety Data Sheets for each product.
B. Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.
C. Condition products to approximately 60 to 70 degrees F for use in accordance with manufacturer's recommendations.
D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheet.

1.7 PROJECT CONDITIONS

A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.
B. Ensure substrate is dry.
C. Protect adjacent work from contamination or damage.

1.8 WARRANTY

A. Provide manufacturer's twenty (20) year limited warranty against failure of structural adhesion, staining, and weatherseal.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Single Source: All materials, including joint sealers, cleaners, and primers shall be of a single source manufacturer.
B. Acceptable Manufacturers:
    1. Dow Corning
    2. Sika
    3. Tremco
    4. Pecora
    5. Approved Equal

2.2 MATERIALS

A. One-part, ultra low modulus, silicone sealant: DOW CORNING 790 Silicone Building Sealant, SIKA Sikasil WS 295, or TREMCO Spectrem 2, Conforming to ASTM C920, Type S, Grade NS, Use NT, M, G, A, and O.
B. Preformed, pre-compressed, expanding foam joint seals for expansion joints in exterior walls.
    1. Basis of Design: Emshield WFR2 by Sika Emseal.
    2. Silicone coated, ultraviolet resistant, dual-faced, fire-rated, watertight primary wall seal.
    3. Form: Precompressed to less than design joint size, packaged in shrink-wrap packaging.
    4. Fire protection rating: 2 hours, tested to UL 2079.
    5. Movement capability: Plus and minus 50% (total 100%) of nominal material size.
    6. R-value: 1.03 per inch depth at nominal joint size compression, tested to ASTM C518.
    7. STC rating: 62 in STC 68 wall, tested to ASTM E90.
    8. OITC rating: 52 in OITC 52 wall, tested to ASTM E90.
    9. The following maximum air permeability meets requirements of the Air Barrier Association of America (AABA).
    10. Air permeability: Maximum 0.02 liter per second per square meter, tested to ASTM E283 at 75 Pa.
    11. Water penetration: No water penetration, tested to ASTM E331 at 5000 Pa test pressure.
    12. Wind loading: No deflection, tested to ASTM E330 at 4954 Pa or 200 MPH wind.
    13. VOC Emissions: CDPH-1.2-2017: Pass

14. Color to be selected by Architect.
15. Adhesive: Epoxy type, furnished by joint seal manufacturer.
16. Silicone: Field applied corner bead at face of seal to substrate interface, furnished by joint seal manufacturer, in same material and color as used in factory coating.
17. Abrasion Resistance: Less than 1% weight loss, tested to ASTM D4060
18. Fuel Resistance: Pass, tested to ASTM C719/C1135
19. Intumescent Sealant: Field applied to face of joints, furnished by joint seal manufacturer.

C. Poured Flexible Epoxy Joint Filler: two component 100 percent solids epoxy joint filler with flexible, pourable, self-leveling properties.
   1. Shore A Hardness: 85 plus or minus 5.
   2. Shore D Hardness: 34.
   3. Elongation: 75 percent.
   4. Tensile Strength: 655 pounds per square inch plus or minus 10 pounds per square inch.
   5. Mixing Ratio: 1 to 1 by volume.
   6. Pot Life: 40 to 55 minutes at 75 degrees F.

2.3 ACCESSORIES

A. Primer: As required by sealant manufacturer
B. Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.
C. Backer Rod: Open or closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.
   1. Comply with ASTM C 1330
   2. Size required for joint design

D. Bond Breaker: Pressure-sensitive tape polyethylene or Teflon recommended by sealant manufacturer.
E. Masking Tape: Pressure-sensitive paper tape

2.4 COLOR

A. Sealant Colors: Selected by the Fire Department Representatives from manufacturer's master color system.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Inspect all areas involved in work to establish extent of work, access, and need for protection of surrounding construction and public spaces.
B. Conduct pre-application inspection of site verification with an authorized manufacturer's representative.
C. The drawings generally indicate locations of joint sealers. The Contractor shall examine the building prior to bidding to determine the quantity and location of all sealant joints. The Contractor shall be responsible for the preparation and replacement of joint sealers in ALL joints whether specifically shown on the drawings or not.

3.2 PREPARATION

A. Remove loose materials and foreign matter which impair adhesion of joint filler.
B. Clean joints by grinding, sandblasting, or wire brushing to expose a sound surface free of contamination and laitance.
C. Ensure structurally sound surfaces, dry, clean, free of dirt, moisture, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials, and other foreign matter.
D. Prime the bond line using Prime Coat where required by the sealant manufacturer installation instructions or as required for proper adhesion, allowing a minimum of one hour drying and cure time before installing sealant. Primer should be within shelf life and poured from containers onto rags, or into applicator bottles that can be

poured onto rags. If brushes are used, primer should be poured a small amount at a time into another open container to avoid contaminating primer and to minimize primer being exposed too long. Pour out no more than can be applied in 30 minutes. If primer becomes cloudy or contaminated, discard. Prime no more substrate than can be sealed in one day or shift.

E. Where the possibility of joint filler staining of adjacent areas or materials exists, mask joints prior to application.
   1. Do not remove masking tape before joints have been tooled and initial cure of joint filler has taken place.
   2. Work stained due to failure of proper masking precautions will not be accepted.

3.3 INSTALLATION

A. Solvent clean aluminum and any other non-porous surfaces with recommended solvent using the “Two Cloth Cleaning Method”.
B. Apply primer according to manufacturer’s instructions.
C. Back-Up Material:
   1. Install backer rod using blunt or rounded tools to assure uniform depth (+/- 1/8”) without puncturing or twisting. Closed cell rod shall be a minimum 20% oversized. Open cell rod shall be a minimum 50% oversized. Install bond breaker tape in shallow joints.
   2. Install polyethylene joint filler in joints wider than 1/4 inch to back-up material per manufacturer's recommendations.

D. Bond Breaker: Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material; install per manufacturer's recommendations.
E. Sealant:
   1. Mask or protect adjacent areas that are not to receive sealant.
   2. Apply sealant in joints using a pressure gun with nozzle cut to appropriate size. Deposit sealant in a uniform and continuous bead with no gaps or air pockets.
   3. Tool joints to require configuration with a blunt instrument as soon as possible after installation, but before sealant begins to skin over. Remove all masking materials immediately after tooling.
   4. Apply materials only within manufacturer's specified application life period. Discard sealant after application life is expired or if prescribed application period has elapsed.

F. Joints shall have a minimum width to depth ratio of 2:1. Finished joint cross section shall have an hourglass shape.

3.4 CLEANING

A. Remove uncured sealant and joint filler with Reducer 990, xylene, toluene, or MEK. Remove cured sealant and joint filler by razor, scraping, or mechanically.
B. Remove all debris related to application of sealants from job site in accordance with all applicable regulations for hazardous waste disposal.

3.5 SCHEDULE OF JOINT SEALERS

A. General-Purpose Interior and Exterior Applications:
   1. Sealant: One Part Silicone Building Sealant
   2. Applications: All exterior joints

B. Exterior Horizontal Applications:
   1. Sealant: Pourable Flexible Epoxy Joint Filler.
   2. Applications:Concrete expansion and construction joints.

C. Exterior Vertical Expansion Joints: Preformed, pre-compressed, expanding foam joint seals.

END OF SECTION

SECTION 08 11 00
STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of steel doors and frames.
B. All doors and frames shall be hot-dipped galvanized.

1.3 RELATED WORK

A. Section 08 71 00 - Door Hardware
B. Section 09 90 00 - Painting

1.4 QUALITY ASSURANCE

A. Standards: Provide steel doors and frames by a single manufacturer specializing in the production of this type of work, and complying with the Steel Door Institute "Recommended Specifications Steel Doors and Frames" (SDI-100).

1.5 REFERENCE DOCUMENTS

A. SDI Standards
1. SDI-106-1999 Recommended Standard Door Type Nomenclature
2. SDI-108-1999 Recommended Selection and Usage Guide for Standard Steel Doors
3. SDI-111-2000 Recommended Details and Guidelines for Standard Steel Doors, Frames, and Accessories
4. SDI-112-1997 Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
5. SDI-117-2000 Manufacturing Tolerances for Standard Steel Doors and Frames
6. SDI-118-2002 Basic Fire Door Requirements
7. SDI-124-1998 Maintenance of Standard Steel Doors and Frames

B. ANSI Standards
1. ANSI/UL 10B-1997 Fire Tests of Door Assemblies
2. ANSI/UL 10C-1998 Positive Pressure Fire Tests of Door Assemblies
3. ANSI/UL 1784-2001 Air Leakage Test of Door Assemblies
4. ANSI/NFPA 80-1999 Fire Doors and Fire Windows
5. ANSI/NFPA 252-1999 Fire Tests of Door Assemblies
6. ANSI/SDI A250.3-1999 Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
7. ANSI/SDI A250.4-2001 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
8. ANSI/SDI A250.6-1997 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
9. ANSI/SDI A250.7-1997 Nomenclature for Standard Steel Doors and Steel Frames
10. ANSI/SDI A250.10-1998 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
11. ANSI/SDI A250.11-2001 Recommended Erection Instructions for Steel Frames (Formerly SDI-105)
12. A115 Hardware Preparation in Steel Doors and Steel Frames
13. A115.IG Installation Guide for Doors and Hardware

C. ASTM Standards
   1. ASTM A1008-2003 Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   2. ASTM A568-2003 Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
   3. ASTM A1011-2001 Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   4. ASTM A591-1998 Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications
   5. ASTM A653-2002 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   6. ASTM A924-1999 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.6 TEST PROCEDURES

A. The products furnished under this standard shall have demonstrated successful performance to the following established standard test methods:
   1. ANSI/SDI A250.3 – Test Procedure and Acceptance Criteria for Factory Applied Finished Painted Steel Surfaces for Steel Doors and Frames
   2. ANSI/SDI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
   3. ANSI/SDI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

1.7 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with all requirements.
B. Shop Drawings: Submit shop drawings detailing elevations of each door design, door construction details and methods of assembling sections, hardware locations, dimensions, and shapes of materials, anchorage and fastening methods, door frame types and details, and finish requirements. SDI-111, “Recommended Details and Guidelines for Steel Doors, Frames, and Accessories” and SDI-106, “Recommended Standard Door Type Nomenclature” shall be used as guides in the development of the necessary product schedule.
C. Provide schedule of doors and frames using same reference numbers for details and openings as those on the contract drawings.

1.8 DELIVERY, STORAGE AND HANDLING

A. Delivery: All hollow metal work shall be delivered cartoned and crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished work.
B. Protection: Use all means necessary to protect the work of this section before, during and after installation and to protect the installed work of all other trades.
C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 STEEL SPECIFICATIONS

A. All steel used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements.
   1. Cold rolled steel shall conform to ASTM A1008, “Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved

Formability" and A568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for."

2. Hot rolled, pickled and oiled steel shall comply with ASTM A1011, "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability" and A568, "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements"
3. When specified, hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM A924, "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process" and A653, "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process". The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 oz/ft², total both sides, i.e., A40 (ZF120). See SDI-112 "Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames" for further information.
4. When zinc coated steel is specified for anchors and accessories, and electrolytically deposited zinc coated steel is provided, it shall comply with ASTM A591, "Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications". The minimum coating weight shall be a class "B", i.e., 0.075 oz/ft².

2.2 PRIME FINISH

A. Doors and frames shall be thoroughly cleaned and chemically treated to insure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

2.3 FIELD APPLIED FINISH PAINT

A. Unless doors and frames are factory finish painted, a compatible coat of finish paint shall be applied in the field. The finish paint shall be of a type recommended for use on primed steel. Consult the door and frame manufacturer's literature for description of primer used.

2.4 TOLERANCES

A. SDI-117, "Manufacturing Tolerances for Standard Steel Doors and Frames" shall apply to the standard steel doors and frames specified.

2.5 DOOR FACES AND EDGE

A. Full Flush: Each door face shall be formed from a single sheet of steel. There shall be no visible seams on the surface of the faces. A full height vertical seam is permitted on door edges.
B. Seamless: In addition to the requirements for full flush doors, no visible seams are permitted along the vertical edges. One of the following methods, at the discretion of the manufacturer, shall be used when a seamless door is specified:
   1. Vertical seam edge filled, dressed smooth
   2. Intermittently welded seams, edge filled, dressed smooth
   3. Continuously welded seam dressed smooth

C. Door edges shall be fabricated utilizing the following different profiles:
   1. Square Edge – edge of door which is 90° to the face
   2. Beveled Edge – edge of a door which is not at a 90° angle to the face of the door (standard bevel is 1/8" in 2" – narrow side of door is in contact with stop of frame when door is closed.

D. End Channels or Closures: The top of the door shall be closed with fully welded flush channel. Bottom of door shall be fully closed with fully welded inverted channel or closures. The channels or closures shall have a minimum material thickness of 0.042".

E. Decorative Faces: When specified, door faces shall be fabricated of textured and/or embossed steel.
F. Core Construction:
   1. Interior Doors: Polystyrene core with Vertical Steel Stiffeners

2.6 FRAMES

A. General: Provide steel frames for doors, transoms, sidelites, mullions, interior glazed panels and other openings, where indicated. Provide either knockdown field assembled type, or welded unit type frames as specified.
B. Slip-On Drywall Frames: When frames are specified for installation in existing drywall construction, they shall be of the slip-on drywall type.
C. Face Welded: The joint between the head and jamb faces shall be completely arc welded along their length either internally or externally. The remaining elements of the frame profile, i.e., soffit, stops, rabbets, are not welded. Face joints shall be ground and finished smooth with no visible seam. Face joints at meeting mullions or between mullions and other frame members shall be completely arc welded externally, ground, and finished smooth.
D. Fully Welded: The joints between all elements of the head and jamb profiles, i.e., soffit, stops, rabbets, faces and returns, shall be completely arc welded. Faces and returns may be arc welded either internally or externally, all other frame elements shall be welded internally. Faces and returns shall be ground and finished smooth with no visible seam. The joint at other frame elements shall appear as a hairline seam on the external side. Face joints at meeting mullions or between mullions and other frame members shall be completely externally welded on the faces only, welds shall be ground and finished smooth. The meeting joints of other mullion profile elements are not welded.
E. Welded frames shall be provided with a temporary spreader bar for shipping and handling purposes only. This temporary spreader bar shall be removed and a setting spreader, supplied by the installer, shall be used for installation of the frame. See ANSI/SDI A250.11, “Recommended Erection Instructions for Steel Frames” for details.

2.7 STANDARD GAGES FOR DOORS AND FRAMES

A. All steel interior and exterior doors shall be 16 Gauge.
B. All steel interior frames shall be 16 Gauge.

2.8 FRAME ANCHORS FOR WALL CONDITIONS

A. Provide frames, other than slip-on drywall type, with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042" in thickness or 0.167" diameter wire. Frames OVER 7'6" shall be provided with an additional anchor.
B. Slip-On Drywall Frame Anchors: Slip-on drywall frames shall have an anchoring system that is an integral part of the frame, and allows installation of the frame after the wall has been constructed.
C. Base Anchors: Provide frames, other than slip-on drywall type, with base anchors that are not less than 0.042" in thickness for attachment to the floor. For wall conditions that do not allow for the use of a floor anchor, an additional jamb anchor shall be specified.

2.9 HARDWARE PREPARATION

A. Reinforcings: Provide minimum hardware reinforcing gages as noted in Table 4 and ANSI/SDI A250.6, “Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.” For additional information refer to A115.IG, “Installation Guide for Doors and Hardware.”
B. Surface Applied Hardware: When specified, doors and frames shall be reinforced for surface applied hardware. Drilling and/or tapping shall be completed by others.
C. Anchor or Pivot Reinforced Hinges: Where anchor hinges are specified, the appropriate recessing and reinforcing shall be provided. Mounting holes shall be field drilled and tapped by others.

D. Hinge Preparations: See Table 5. Doors 6'8", 7'0", and 7'2" high require three (3) hinge preparations. Doors over 7'6" to 8'0" high require four (4) hinge preparations. Exception: 1-3/8" thick, 6'8" high non-fire rated doors shall be prepared for two hinge preparations.
E. Hardware Locations: Hardware shall be located in accordance with Table 5. Other items of hardware shall be located according to the door and/or hardware manufacturer's directions. This includes the door closers, floor hinges, overhead door holders, pocket pivot, and most specialized-purpose hardware.

PART 3 – EXECUTION

3.1 JOBSITE STORAGE

A. All doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" high wood sills or in a manner that will prevent rust or damage. The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided. A 1/4" space between the doors shall be provided to promote air circulation. If the wrapper on the door becomes wet, it must be removed immediately. Proper jobsite storage is extremely important in maintaining the quality and integrity of the factory applied paint. IMPROPER STORAGE of material WILL HAVE an adverse effect on the factory applied paint's ability to meet the requirements of ANSI/SDI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames" or ANSI/SDI A250.3, "Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames."

3.2 INSPECTION

A. Installer must examine substrates and conditions under which steel doors and frames are to be installed, and must notify Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 FRAME INSTALLATION

A. Frames shall be installed plumb, level, rigid, and in true alignment as recommended in ANSI/SDI A250.11 "Recommended Erection Instructions for Steel Frames" and A115.IG, "Installation Guide for Doors and Hardware". All frames, other than drywall slip-on types, shall be fastened to the adjacent structure so as to retain their position and stability. Slip-on drywall frames shall be installed in prepared wall openings in accordance with manufacturer's instructions.

3.4 DOOR INSTALLATION

A. Doors shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance. Doors shall be adjusted to maintain perimeter clearances as specified in Section 3.5 Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.

3.5 INSTALLATION CLEARANCES

A. The clearance between the door and frame shall be a maximum of 1/8" in the case of both single swing and pairs of doors.
B. The clearance measured from the bottom of the door to the bottom of the frame (Undercut) shall be a maximum of 3/4" unless otherwise specified.
C. The clearance between the face of the door and the stop shall be 1/16" to 3/32".
D. All clearances shall be, unless otherwise specified in this document, subject to a tolerance of ±1/32".

3.6 HARDWARE INSTALLATION

A. Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. A115.IG, "Installation Guide for Doors and Hardware" and ANSI/SDI A250.6, "Recommended

Practice for Hardware Reinforcing on Standard Steel Doors and Frames" shall be consulted for other pertinent information.

3.7 ADJUST AND CLEAN

A. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition. Remove and replace defective work including doors and frames which are warped, bowed or otherwise unacceptable.
B. Prime Coat-Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

Minimum hardware reinforcing thickness

Hardware Item	Door			Frame		
	inches	mm	MSG No. (6)	inches	mm	MSG No. (6)
Flush Bolt Front	0.067	1.7	14	0.067	1.7	14
Surface Bolt (3)	0.067	1.7	14	0.067	1.7	14
Surface Applied Closer (4)	0.067	1.7	14	0.067	1.7	14
Hold Open Arm (3)	0.067	1.7	14	0.067	1.7	14
Pull Plates and Bar (3)	0.053	1.3	16	0.053	1.3	16
Surface Exit Device (3)	0.067	1.7	14	0.067	1.7	14
Floor Checking Hinge	0.167	4.2	7	0.167	4.2	7
Pivot Hinge	0.167	4.2	7	0.167	4.2	7
Continuous Hinges (5)	Not Required			Not Required		
Kick / Push Plate	Not Required			Not Required		

Note: The minimum steel thickness for each specific gage is derived from the published figures of Underwriters Laboratories Inc.

(2) If reinforcing is angular or channel shaped, 0.093" (2.3 mm) is permitted.

(3) When reinforcing is omitted, thru-bolting via the use of spacers or sex-bolts is required.

(4) Reinforcement shall occur on both sides.

(5) Refer to ANSI/SDI A250.6, "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames."

PART 1 Hardware locations

Hinges	Top	Up to 13" (330.2 mm) from Bottom of Frame to Centerline of Hinge
	Bottom	Up to 13" (330.2 mm) from Bottom of Frame to Centerline of Hinge
	Intermediate	Equally Spaced Between Top and Bottom Hinges

END OF SECTION

SECTION 08 31 00
ACCESS DOORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the supply and installation of access doors, as specified herein and delineated on the drawings.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for fabrication and installation, including
B. data substantiating that products comply with all requirements.

PART 2 – PRODUCTS

2.1 ACCESS DOORS

A. Stainless Steel Type 304, # 4 finish, 20-gauge frame and door panel
B. Hinge: Heavy duty butt hinges. Extracting pin from hinge leaf attached to panel permits panel removal. Number of hinges varies with size of door.
C. Lock: Tamper proof security cam lock.
D. Frame: 2” x 2” x 3/16” angle frame.

2.2 FIRE RATED ACCESS DOORS

A. Stainless Steel Type 304, # 4 finish, 20-gauge frame and door panel. Door flush to frame with reinforced edges. Flange 1” wide.
B. Door Frame: Stainless Steel: 16-guage mounting frame.
C. Insulation: Door to be filled with 2” thick fire-rated insulation
D. Flange: 1” wide.
E. Hinge: Concealed spring hinges open to 175 degrees. Extracting pin from hinge leaf attached to panel permits panel removal. Number of hinges varies with size of door.
F. Lock: Tamper proof security cam lock.
G. Provide firerated access doors when installed in rated walls or ceilings no less than the rating of that wall or ceiling assembly
H. Size: As shown as Drawings.
I. Finish: #4 satin polish.

PART 3 – EXECUTION

A. General: Install doors, frames, and accessories in accordance with final, approved shop drawings
B. and manufacturer's installation instructions.

END OF SECTION

SECTION 08 36 13
SECTIONAL DOORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specifications Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of overhead sectional doors.

1.3 RELATED WORK

A. Section 06 10 00 – Rough Carpentry

1.4 SUBMITTALS

A. Product Data: Completely describing components and performance
B. Shop Drawings: Showing details of fabrication, installation and accommodation to connecting work
C. Installation Instructions: For door and accessories
D. Operating and Maintenance Data
E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide each sectional overhead door as a complete unit produced by a single manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, and operator.
B. Inserts and Anchorages: Furnish inserts and anchoring devices to be set, anchored or built into masonry; or drilled and tapped or welded to structural steel.
C. Installer Qualification: Door manufacturer or trained, approved and licensed door installer.

1.6 WARRANTEE

A. Provide manufacturer’s warrantee that door, hardware, fittings, tracks, and operator will be free of defects in workmanship and material for a period of (1) year of acceptance of the installation. The installing Contractor shall, upon notification, correct such non-conformity at its option, by repairing or replacing any defective part or parts. This limited warranty does not include normal wear.
B. Panel Limited Warranty: The door sections against defects in material and workmanship, and deterioration due to rust-through for ten (10) years from date of delivery to the original purchaser.

PART 2 – PRODUCT

2.1 DESCRIPTION

A. Commercial sectional door with heavy gauge track and hardware and chain hoist.

B. General Performance Requirements:
   a. R-Value: 17.40
   b. U-Value: .057
   c. Thermal Break: PVC
   d. Air Infiltration: at 15mph, .08cfm/ft2

2.2 DOOR SECTIONS

A. Door panels to be constructed of steel pan construction, 2 inches thick, roll formed from 20-gauge draw quality, hot-dipped galvanized (G40 exterior) steel complying with ASTM A 653. Sections shall have tongue-and-groove joints for weather-tight closure. Section end stiles to be 18-gauge galvanized steel and center stiles to be 20-gauge galvanized steel. End stiles to be crimp-locked to the section skin. Center stiles to be glued and crimp-locked to section skin. Panel color to be white.
B. Windows: Locations to comply with door elevation drawings.
C. Performance Requirements:
   1. Panel Thickness: 2”
   2. Size: As shown on Drawings
   3. Exterior Surface: To be determined by Architect
   4. Sound Transmission Rating: Class 26
   5. Color: To be determined by Architect

2.3 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Provide manufacturer’s standard lower track to be constructed of formed 12-gauge galvanized steel. Between-Jamb Bracket Mounting: sections mounted between door jambs, seal against exterior perimeter seal installed along vertical and top horizontal edges of jambs. Hot-dipped galvanized steel (ASTM A 653), fully adjustable for adequate sealing of door to jamb or weatherseal.
B. Lap Jamb Angle Mounting: section overlap door jambs by 1 inch on each side of door opening
C. Weatherseal: Provide complete weather-stripping system to reduce air infiltration. Weather stripping shall be replaceable. Bottom of door to have flexible U-shaped vinyl seal retained in aluminum rail and optional blade seal on top section to prevent airflow above header.
D. Furnish door system with locks: Exterior lock with five-pin tumbler cylinder, night latch, and steel bar engaging track.

2.4 HARDWARE

A. General: Provide heavy-duty, rust-resistant hardware with galvanized, zinc-plated or stainless steel to suit type of door.
B. Hinges and Brackets: Fabricated from galvanized steel.

2.5 COUNTERBALANCE

A. Counterbalance System: Provided with aircraft-type, galvanized steel lifting cables with minimum safety factor of 5. Torsion Springs consisting of heavy-duty oil-tempered wire torsion springs on a continuous ball-bearing cross-header shaft.
B. Spring Cycle Requirements: Standard 25,000 cycles.

2.6 MANUAL DOOR OPERATORS

A. Door to be designed with Electric Chain Hoist Operator.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory. Verify opening size, dimensions and tolerances.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Protect surrounding areas and surfaces to prevent damage during work of this Section.
B. Clean surfaces thoroughly prior to installation.
C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. General: Install door, track and operating equipment complete with necessary hardware, anchors, inserts, hangers and equipment supports according to shop drawings, manufacturer’s instructions and as specified.
B. Fasten track assembly to framing as specified in manufacturer’s installation manual. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door opening equipment.
C. After completing installation, including work by other trades, test and adjust doors to operate easily, free from warp, twist or distortion, fitting weather-tight and knockout as detailed in manufacturer's standard performance specifications.

3.4 CLEANING

A. Leave the premises clean and free of residue of work of this Section.

END OF SECTION

SECTION 08 53 00
WOOD WINDOWS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the supply and installation of wood and composite material-framed casement windows, with fiberglass sash components.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Provide products/systems that have been manufactured, fabricated, and installed to the following performance criteria:
   1. Comply with ANSI/AAMA/NWWDA 101/I.S.2
   2. Performance Class: Class LC-PG50
   3. Performance Grade: PG 50
   4. U-Factor: 0.27 Maximum.
   5. Solar Heat Gain Coefficient (SHGC): 0.27
   6. Outdoor-Indoor Transmission Class (OITC) (ASTM E90): 24
   7. Sound Transmission Class (STC) (ASTM E90): 33

B. Structural Requirements: Provide products/systems capable of withstanding wind loads based on testing units representative of those indicated for Project that pass AAMA/NWWDA 101/I.S.2/NAFS, Uniform Structural Load Test:
   a. Refer to Drawings for all Structural Loading Criteria

1.4 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 61 00.
B. Product Data: Submit manufacturer's product data and installation guides.
C. Shop Drawings: Provide drawings indicating direction of operable parts, typical jamb, head, and sill conditions, and special mullion reinforcement details.
D. Color Samples: Submit selection and verification samples, including the following:
   1. Hardware: Submit sample indicating typical finish on hardware.
   2. Cladding: Submit color samples of exterior cladding.
E. Quality Assurance/Control Submittals: Submit the following:
   1. Performance Data: Provide manufacturer's published performance data for specified products.

F. Contract Closeout Submittals: Submit the following:
   1. Warranty documents specified herein.
   2. Owner's Manual: Bound manual clearly identified with project name, location, and completion date. Identify type and size of units installed. Provide recommendations for periodic inspections, care, and maintenance. Identify common causes of damage with instructions for temporary repair.

1.5 QUALITY ASSURANCE

A. Certifications:
   1. Insulating Glass Units: Provide insulating glass units permanently marked with certification label of Insulating Glass Certification Council (IGCC) indicating compliance with ASTM E2190.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Delivery: Deliver materials in manufacturer's original unopened, undamaged containers with identification labels intact.
C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
D. Store materials and accessories off ground, under cover, and protected from weather and construction activities.

1.7 PROJECT CONDITIONS

A. Pre-Installation Meeting: Contract shall arrange and conduct a pre-installation meeting with the Architect's representative and the window manufacturer's technical representative to clarify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.
B. Field Measurements: Verify actual dimension of openings by field measurement before fabrication. Record measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
C. Install units in strict accordance with manufacturer's safety and weather recommendations.

1.8 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for Project Warranty provisions.
B. Manufacturer's Warranty: Submit, for Owner's acceptance, Manufacturer's transferrable, non-prorated limited warranty. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
    1. Warranty Period, Glass: 10 years
    2. Warranty Period, Non-Glass Parts: 10 years.
    3. Warranty Period, Exterior Coating, Fading, and Hardware Corrosion:
        a. Exterior Coating: Limited lifetime of the original structure
        b. Fading: 20 years
        c. Hardware Corrosion: 10 years

C. Special Warranty: Installer's standard form in which installer agrees to repair or replace windows that fail due to poor workmanship or faulty installation within the specified warranty period. Warranty Period: 5 years from date of Substantial Completion.

1.9 LABELING

A. Windows shall be labeled and certified by the manufacturer, indicating the U-Value, the SHGC, and VT as determined in accordance with NFRC 200 by an accredited independent laboratory.
B. Refer to Item 2.4(A) for required permanent labeling of glazing.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Product/Systems: Wood and composite material-framed casement windows, with fiberglass sash components complying with the performance requirements indicated and tested according to the NAFS (North American Fenestration Standard/Specification for windows, doors, and skylights).
B. Window Type and Performance Requirements: Casement Performance Class LC and Grade, PG50
C. Air Infiltration Requirements: Air Infiltration Rate: < 0.2 cfm/sf².

2.2 MATERIALS

A. Exterior Frame: Extruded composite profile consisting of 40 percent reclaimed pre-consumer wood fiber and 60 percent thermoplastic polymer, by weight.
B. Exterior Sash: Pultruded fiberglass.
C. Interior Exposed Frame: Preservative treated solid lumber (WDMA I.S.4), kiln dried and suitable for stain or painted finish.
D. Interior Exposed Sash: Preservative treated solid lumber (WDMA I.S.4), kiln dried and suitable for stain or painted finish.
E. Wood Species: Pine
F. Interior Finish: Stained: Factory-applied before assembly, water-based, color to be selected by Architect.
G. Exterior Finish:
    1. Painted Frame: Factory electrostatically-applied acrylic enamel, in compliance with AAMA 615/AAMA 625, Color = White
    2. Painted Sash: Factory electrostatically-applied acrylic enamel, in compliance with AAMA 615/AAMA 625, Color = White

2.3 WEATHERSTRIPPING

A. Weatherstripping: Flexible tubular vinyl.
B. Attachment Flange Type: Extruded vinyl

2.4 GLAZING

A. Low-E4
   Thermal Transmission (U-Factor), NFRC 100: 0.29 Maximum.
B. Solar Heat Gain Coefficient (SHGC), NFRC 200: 0.26
C. Visible Light Transmittance (VLT), NFRC 200: 0.45
D. Glass Units: Provide insulating glass units certified through Insulating Glass Certification Council as conforming to the requirements of IGCC and ASTM E2190
    1. Glazing Configuration: Dual-pane
    2. Tint: None
    3. Seal and Spacer Type: Dual sealed insulating glass units with polyisobutylene primary seal, silicone secondary seal and stainless steel spacers.
    4. Glass Spacer Color: White
    5. Glass Type: Fully tempered glass, ASTM C1048

2.5 VENTILATING HARDWARE

A. Operator Gear Type and Material: Rotary, Die-cast coated carbon steel and stainless-steel components
B. Hinge Type and Material: 200 and 300 series stainless steel
C. Operator Style: Contemporary folding, die-cast zinc.
D. Finish: As selected by Architect
E. Provide standard casement hardware. Finish to be selected by Architect.

2.6 INSECT SCREENS

A. Insect Screens: Type, Casement: Conventional full.
    1. Frame Material: Aluminum.
    2. Painted Finish and Color: Color as selected by Architect from manufacturer’s available exterior colors.
    3. Insect Screen Material: Aluminum wire cloth.

2.7 ACCESSORIES

A. Extension Jambs: Factory Applied as detailed on drawings. Custom to match interior trim and finish
B. Exterior Trim and Accessories:
   1. Type: Window manufacturer's integrated brick mold and sill nose trim
   2. Material: Fibrex material wood-polymer composite
   3. Finish and Color: Color to be selected by Owner.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the window manufacturer.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify that site conditions are acceptable for installation of units, including the following:
   1. Rough openings are square and dimensions are correct.
   2. Sill plates are level.
   3. Fasteners heads are driven flush with surfaces in openings and within 3 inches of rough opening.
   4. Do not begin installation until substrates have been properly prepared and any conditions not in compliance with manufacturer's recommendations have been corrected.

3.3 INSTALLATION

A. Installation of windows shall comply with manufacturer's installation instructions.
B. General:
   1. Remove unit components, parts, accessories, and installation guides from carton.
   2. Inspect unit components and verify that components are not damaged and that parts are included before disposing of carton.
   3. Shop-assemble multiple units before installation in accordance with manufacturer's installation guides.
   4. Field-assemble multiple units before installation in accordance with manufacturer's installation guides.

C. Interface with Other Work:
   1. Perform installation in accordance with Manufacturer's instructions.
   2. Install units level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
   3. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
   4. Install insulation in shim space around unit perimeter to maintain continuity of building insulation. Do not overfill.
   5. Hold back exterior siding or other finish materials from edge of unit to allow for expansion and contraction and installation of proper joint sealant with backing materials. Seal perimeter of unit after exterior finish is applied per requirements of Section 07 92 00 Joint Sealants.
   6. Finish interior units per requirements specified in related sections. Refer to, and comply with, additional requirements in manufacturer's installation guides.
   7. Install optional hardware and unit accessories after cleaning.

D. Site Tolerances: Adjust operation, insect screens, hardware, and accessories for a tight fit at contact points and weatherstripping for smooth operation and weathertight closure.

3.4 CLEANING

A. Clean units using cleaning material and methods specifically recommended by window manufacturer.
B. Remove excess sealants, glazing materials, dirt, and other substances.
C. Avoid damaging protective coatings and finishes.
D. Protect unit surfaces from masonry cleaning solution that could damage insulation glass panels or hardware.
E. Remove debris from work site and properly dispose of debris.

3.5 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 08 71 00
FINISH HARDWARE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of finish hardware as scheduled on the drawings and specified herein.

1.3 RELATED ITEMS

A. The following related items are specified in other sections of this specification:
   1. Steel Doors and Frames – Section 08 11 00

1.4 QUALITY ASSURANCE

A. Manufacturer: Obtain each kind of hardware from only one manufacturer, although several may be indicated as offering products complying with requirements.
B. Codes and Regulations: All hardware furnished shall meet requirements of Federal and State Codes and Standards having jurisdiction over this installation.
C. Hardware shall be suitable and adapted for its required use and shall fit its designated location. Should any hardware as shown, specified or required fail to meet the intended requirements or require modification to suit or fit the designated location, determine the correction or modification necessary and notify the Architect in ample time to avoid delay in the manufacture and delivery of hardware.
D. Hardware Supplier Qualifications: The Hardware Supplier shall have an AHC of the Door and Hardware Institute on staff who will be responsible for overseeing the scheduling, detailing, ordering, and coordinating of Finish Hardware, and shall be available for consultation with the Architect, at no additional cost to the Owner, during progress of construction. The Hardware Supplier shall be a direct factory authorized distributor for all Finish Hardware items being furnished in accordance with this Specification.

1.5 SUBMITTALS

A. Product data: Submit manufacturer's technical information for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.
B. Hardware Schedule: The general Contractor, through his hardware supplier, shall submit to the Architect, copies of a detailed hardware schedule describing in detail the finishing hardware for all door openings, or occurrence of finish hardware.
   1. Type, style, function, size and finish of each hardware item.
   2. Name and manufacturer of each item.
   3. Fastenings and other pertinent information.
   4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in schedules.
   5. Explanations of all abbreviations, symbols, codes, etc. contained in the schedule.
   6. Mounting location of hardware
   7. Door and frame sizes and materials.
   8. Include with schedule the product data, samples, shop drawings of other work affected by builder’s hardware, and other information essential to the coordinated review of hardware schedule.

C. Where submission differs from the Hardware Schedule provided in the architectural drawings, use different color or other means of identification to bring change to the attention of the Architect.

1.6 JOB CONDITIONS

A. Delivery, Handling and Storage: Pack finish hardware in approved manufacturer's containers, complete with trimmings, bolts, screws, washers, etc., as required for application and securement. Each container shall bear a suitable label which shall state the quantity and kind of contents of said container, as well as identifying marks relating to the approved Hardware Schedule and its location in the project.
B. Lever handles, pulls and other items of finish hardware with easily damaged finishes shall be individually wrapped before placing in containers and with sufficient sheet cloth or cotton-backed paper which shall be adequately tied with heavy strings; all as necessary to protect the finishes.
C. Finish hardware shall be delivered, as directed, to the building site or the factories of the various fabricators of metal work to which such hardware is to be applied. Deliver hardware in the order required and in ample time to permit application at the building, or fabricators' shops, within the time required for the completion of the building.
D. Templates: Promptly following approval of the Hardware Schedule by the Architect, furnish and deliver template information, to the fabricators, of items to which finish hardware is to be applied. Such deliveries shall be made in ample time to avoid delays in such work of said fabricators. Provide drawings, schedules and detailed information to other trades as necessary for them to accommodate and prepare their work to receive the finish hardware.

PART 2 – PRODUCTS

2.1 GENERAL

A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware are indicated herein. Products are identified by using appropriate hardware designation numbers.
B. Manufacturers are listed for each hardware type required. Provide either the product designated, or approved equal.
C. Barrier-Free Requirements: Comply with all standards of ICC/ANSI 117.1, 2017 and the Americans with Disabilities Act Accessibility Guidelines.
D. Notwithstanding anything to the contrary in this specification or the drawings, the finish hardware shall conform to the requirements of governmental authorities having jurisdiction and such requirements shall be followed as if specifically set forth in this specification.
E. Finish hardware shall conform to the applicable requirements of the American Insurance Association, and the National Board of Fire Underwriters' Laboratories, Inc., and other local authorities having jurisdiction, and each such item shall bear a label or mark of the Underwriters' Laboratories, Inc., indicating its conformity with such requirements for use in connection with its specified location.
F. Finish hardware shall be uniform in color and finish and free from imperfections affecting its appearance, function, operation and serviceability. Such hardware shall be suited and adapted to its required use and shall fit its respective location.
G. Where the finished shape or size of members receiving finish hardware are such as to prevent or render unsuitable the use of the specific types or sizes of such hardware, suitable types or sizes shall be furnished, having as nearly as practicable the same function, operation and quality as the specified hardware.
H. Bolts, screws, and other fastenings required for the application of the finished hardware shall be of size and type to fit requirements and shall be of the same material and finish as the exposed parts of such hardware which they adjoin. Exposed screws and bolts shall have countersunk oval heads and bolts shall be provided with cap nuts. Countersunk part of screw and bolt holes shall be finished smoothly without sharp edges and form a firm seal for such screw and bolt heads. No through bolts will be allowed.

2.2 MATERIALS

A. General:
   1. Schedule of Manufacturers: The manufacturers listed below are to be considered equal for use on this project. The specific manufacturer and model type specified may be supplied by those manufacturers listed in this section, as long as their operation, function and compatibility with other hardware is the same as the listed material.
      a. Hinges: Hager, Stanley, Pemko, or approved equal.
      b. Cylindrical Locksets/Latchsets: Accentra (Formerly Yale), Schlage, Corbin-Russwin, or approved equal.
      c. Door Closers: Accentra (Formerly Yale), Norton, LCN, or approved equal.
      d. Flush Bolts and Kickplates: Trimco, Rockwood, Ives, or approved equal
      e. Weatherstripping: Zero, National Guard, Pemko, Reese, or approved equal.
      f. Saddles, Thresholds, and Weatherstripping: Zero, National Guard, Pemko, Reese, or approved equal.
      g. Wall Bumpers: Trimco, Rockwood, BBW, Quality, or approved equal.
      h. Thresholds: Pemko, Zero, National Guard, Reese, or approved equal.

   2. All materials to be of cast brass or bronze, finish as selected by the Architect, except where specified to the contrary, free from all blemishes and defects. All bolts, screws, etc. for application or hardware shall be of size and type to fit requirements and shall be in harmony with the hardware as to material and finish.
   3. All fasteners shall be of the Phillips head type, except where security type fasteners are required on exterior doors.

B. Hinges: Hinges shall be Hager AB800 4 1/2" x 4 1/2". All hinges to be of five-knuckle construction with non-rising pin. All hinges shall be concealed bearing type having anti-friction bearings not requiring lubrication or maintenance. Hinges must meet or exceed the requirements of ANSI/BHMA Grade 1.

C. Mortise Locksets: All hardware shall comply with ANSI 156.13, Series 1000, Grade 1, operational, strength, and security. Case shall be 5 1/8" high x 7/8" deep x 4 1/16" wide. Steel parts shall be zinc die chromate plated for corrosion resistance. Backset shall be 2-3/4". Latchbolt shall be stainless steel 3/4" throw. Deadbolt shall be stainless steel 1" throw. Unit shall be equipped with lever handle on both the interior and exterior. Inside handle of all non-electrified locksets shall always be free turning for egress. Finish shall be BHMA 630.

D. Cylindrical Locksets/Latchsets: Cylindrical locksets shall be heavy-duty complying with ANSI-A156.2, Series 4000, Grade 1, and shall be listed by Underwriters Laboratories UL10C for use on three hour, A-Label, single or double swing doors. Chassis shall brass or corrosion resistant steel. Backset shall be 2-3/4" with a 1/2" latch throw. Front shall be 2-1/4" x 1-1/8" beveled. Strike shall be ANSI curved lip 4 7/8" lip to center. Inside handle of all locksets shall always be free turning for egress. Trim variation shall be as set forth on the Hardware Schedule.

E. Door Closers: Closers shall be Accentra (Yale) 3501 DL and shall be full rack-and-pinion type. Closer shall be surface mounted and shall project no more than 2-1/8" from the mounting surface. Closer shall be non-handed to permit installation on doors of either hand. Closer to be supplied with a standard shoe and soffit plate to allow regular arm, parallel arm, or top jamb mounting. Hydraulic fluid shall be non-gumming and non-freezing. Closer shall have multi-size spring power adjustment to permit setting of spring power from size 2 through size 4. Closer shall have two non-critical valves, hex-key-adjusted, to independently regulate sweep and latch speeds. Closer shall have adjustable backcheck cushioning controlled by a hex-key-adjusted valve. Regular arm and top jamb closers shall have a non-hold-open shoe permitting a 110 degree hold-open. Provide plastic covers. Closer shall carry a limited warranty on the complete closer assembly.

F. Templates:
   1. Hardware to be supplied to metal doors and frames shall be made to template and furnished with machine screws.
   2. Hardware supplier shall furnish manufacturer of metal doors and/or frames with a complete and detailed hardware schedule. He shall furnish necessary templates, blueprints or physical sample as required by manufacturer in preparing doors and frames to receive hardware.
   3. All reinforcing for template hardware is to be done in the shop.

G. Saddles and Thresholds: Thresholds shall be set in full bed of mastic sealant (two-component polyurethane) and be screwed to the construction using #10 Phillips screws and lead shields. Thresholds shall be mill aluminum finish. All thresholds for this Project shall be ADA and ICC/ANSI A117.1 compliant (maximum direct rise of ¼" or rise of up to ½" if beveled 1:2).
   1. All thresholds are to be of material as specified or as shown and detailed on plans and are to be caulked with approved mastic before anchoring devices are entered into lead shields.
   2. Non-mitered type thresholds that project beyond exterior face of frame are to extend full width of masonry opening, notch as required.

H. Silencers: Furnish silencers as required for interior doors, three each for single doors, two each for pairs of doors, and six each for panels above doors. Use Yale 90n, Sargent 3446, Corbin/Russwin 33, or equal. Silencers are not to be installed until door bucks are painted and dry.

2.3 FINISHES

A. Provide finish hardware in finishes indicated for each item in the hardware sets provided on the drawings. Unless otherwise noted, finish shall be as selected by the Architect.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Finish hardware shall not be installed in the building until the wet trades have been fully completed.
B. Mounting: Mount hardware at locations and height indicated in drawing, in this Section, or, if not specifically indicated, in locations to comply with governing regulations, industry standards and as directed by Architect.
C. Installation: Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and re-installation or application or surface protections with finishing work specified in the Division 9 Sections. Do not install surface mounted items until finishes have been completed on the substrate.
   1. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
   2. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3.2 ADJUST AND CLEAN

A. Adjust and Replace:
   1. Adjust and check operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
   2. Clean adjacent surfaces soiled by hardware installation.
   3. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space of area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.
   4. Adjust door control devices to compensate for final operations of heating and ventilating equipment.

B. Instructions: Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

END OF SECTION

SECTION 08 81 00
GLASS GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this section includes the supply and installation of glass in glazing frames in doors.

1.3 RELATED WORK

A. The following related work is specified under other sections:
   1. Section 08 11 00 - Steel Doors and Frames

1.4 QUALITY ASSURANCE

A. Performance Standard:
   1. Heat treated glass shall comply with ASTM C1048

1.5 STANDARDS AND PERFORMANCE

A. General: Watertight and airtight installation of each glass product is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.
B. Protection: Protect glass from edge damage during handling and installation, and subsequent operation of glazed components of the work. During installation, discard units with significant edge damage or other imperfections.
C. Manufacturer's instructions: Comply with combined recommendations and technical reports by manufacturers of glass and glazing products as used in each glazing channel, and with recommendations of FGMA "Glazing Manual", except where more stringent requirements are indicated.
D. Glazing channels: Dimensions shown are intended to provide for necessary bite of glass, minimum edge clearance, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

1.6 PRODUCT WARRANTY

A. Warranty on hermetic seals: Provide insulating glass manufacturer's written warranty, agreeing to, within specified warranty period, furnish FOB project site, replacement units for insulating glass units which have defective hermetic seals (excluding that due to glass breakage); defined to include intrusion of moisture or dirt, internal condensation at temperatures above -20 degrees F., deterioration of internal glass coatings, and other visual evidence of seal failure or performance failure, provided manufacturer's instructions for handling, installation, protection and maintenance have been adhered to during warranty period.
B. Warranty period is 10 years after seal date permanently imprinted on unit, but not less than 9 years after date of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Glass
   1. Tempered Glass: All glazing for this Project shall be 1/4" heat treated to strength glass in bending to not less than 4.5 times annealed glass. Glazing shall be tested in accordance with CPSC 16 CFR and comply with test criteria for category class II. Each pane of safety glass shall be identified by a manufacturer's designation specifying who applied the designation, the manufacturer or installer, and the safety glazing standard with which it complies, as well as the type and thickness of the glass. The designation shall be acid etched, sand blasted, laser etched, embossed, or of a type that, once applied, cannot be removed without being destroyed.
   2. Insulating units, ASTM C1036-T tested in accordance with ASTM 774 and E 773 methods, meeting SIGMA Industry Standards. Exterior lite shall be 1/4" tempered glass with 1/2" separation space and 1/4" tempered glass interior lite. All exterior glazing to be insulating units.
   3. Fire-rated Glazing and required markings at rated doors:
      a. Door Vision Panel
         1) 60-Minute Rated Doors:
            a) Under 100 sq. in. = D-H-60
            b) 100 sq. in. or more =D-H-T-W-60

B. Miscellaneous Glazing Materials
   1. Cleaner, primers and sealers: Type recommended by sealant or gasket manufacturer.
   2. Setting blocks: Neoprene or EPDM, 70-90 durometer hardness, with proven compatibility with sealants used.
   3. Spacers: Neoprene or EPDM, 40-50 durometer hardness, with proven compatibility with sealants used.
   4. Compressible filler (rod): Closed-cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation For Glazing: Clean glazing channel and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used. Apply primer or sealant to join surfaces where recommended by sealant manufacturer.

B. Glazing:
   1. Install setting blocks of proper size in sill rabbet, located 1/4th of the glass width from each corner. Set blocks in thin course of heel-bead compound, if any.
   2. Provide spacers inside and out, of proper size and spacing, for glass sizes larger than 50 united inches, except where gaskets or pre-shimmed tapes are used for glazing. Provide 1/8" min. bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
   3. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
   4. Voids and filler rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in channel at heel of jambs and head (do not leave voids in sill channels), except as otherwise indicated and depending on size of light, thickness and type of glass, and complying with manufacturer's recommendations.
   5. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

6. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
7. Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and to eliminate stains and discolorations.
8. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel band.
9. Gasket glazing: Miter cut and bond ends together at corners where gaskets are used for channel glazing, so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

3.2 CURE, PROTECTION AND CLEANING

A. Protection: Protect exterior glass from breakage immediately upon installation, by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces. Cure sealants for high early strength and durability.
B. Removals: Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.
C. Cleaning: Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion. Comply with glass product manufacturer's recommendations for final cleaning.

TABLE ONE – GLAZING SCHEDULE

LOCATION	GLASS TYPE	THICKNESS	GLAZING METHOD
Steel Doors	Tempered CPSC 16 CFR Category Class II	1/4”	Gasket Glazing

END OF SECTION

SECTION 09 22 23
FIBER REINFORCED STUCCO

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Installation of new and repair of existing Portland stucco as an exterior wall cladding. The extent of stucco base and finish coat assembly is as indicated on the drawings.
B. The types of stucco basecoat assembly include:
   1. Factory blended plaster basecoat for jobsite mixing to provide fiber reinforced stucco finish.

C. Products installed but not supplied under this section:
   1. Joint Sealant: Refer to Section 07 92 00 for Joint Sealants.

1.2 DESCRIPTION

A. Scratch and Brown stucco that is a factory blended formulation of Portland , lime, and proprietary ingredients. For use with jobsite added ASTM C 897 stucco sand and clean potable water.
B. Scratch and Brown Functional Criteria:
   1. Stucco application shall be sloped a minimum of 4-inch/12 inch (15°) for positive drainage.
   2. Substrate conditions:
      a. substrate shall be sound, dry and free of dust, dirt, and other contaminants.
      b. Substrate Dimensional Tolerances: Flat with 1/4 inch within any 4-foot radius to maintain a uniform thickness of basecoat material.
      c. Maximum deflection of substrate assembly under positive or negative design loads shall not exceed L/360 of span.

1.3 SUBMITTALS

A. General: Applicator to submit:
   1. Manufacturer's technical information including installation instructions and recommendations.
   2. Samples: Submit samples for approval. Samples shall be of materials specified and of suitable size required to accurately represent each color and texture to be used on project. Prepare each sample using same tools and techniques for actual project application. Approved samples shall be maintained and available at job site.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: All stucco basecoat and finish materials shall be from a single manufacturing source.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver manufactured materials in original packages or containers, with manufacturer's labels intact and legible.
B. Keep materials dry, above freezing, stored off ground, under cover and away from damp surfaces. At the time they are mixed, all materials shall be at a minimum temperature of 40°F.
C. Remove wet, frozen, damaged, or detrimental materials from site immediately.

1.6 PROJECT SITE AND INSTALLATION CONDITIONS

A. Environmental Conditions: Comply with manufacturer's recommendations of environmental conditions affecting product installation requirements.

1. Installation Ambient Air Temperature: Minimum of 40ºF and rising and remain so for 48 hours thereafter. Maximum Ambient Air Temperature of 120°F. Protect stucco from uneven and excessive evaporation during hot, dry weather
2. Do not use frozen materials in stucco.
3. Do not apply stucco to frozen surfaces or surfaces containing frost or ice.
4. Inclement Weather: Do not apply basecoat during inclement weather unless appropriate protection is employed.
5. Wall and Substrate Temperatures: Avoid, when possible, installation of the basecoat and the finish coats over substrates that are over 120°F.

B. Protection:
   1. Protect adjacent finished surfaces prior to stuccoing.
   2. Maintain protection in place until completion of work.
   3. Protect finished work when stopping for the day or when completing an area.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Stucco base and finish coats: LaHabra Stucco, Parex, El Ray, or approved equal.

2.2 MATERIALS

A. Stucco Basecoat:
   1. Waterproofing Base Coat. Acrylic co-polymer base. Requires the addition of Portland cement.

B. Water: Potable.
C. Standard Mesh: Weight 4.5 oz. per sq. yd. (153 g/sq m); coated for protection against alkali. Standard reinforcement of EIFS, or for use with High Impact 358.14 Mesh, or Ultra High Impact 358.20 Mesh.
D. Primer: 100% acrylic based coating to prepare surfaces for finishes
E. 100% acrylic polymer based finish, integrally colored. Finish type, texture and color as selected by Architect
F. Portland Cement: ASTM C150, Type I or Type I-II.
G. Accessories:
   1. Sealants shall conform to ASTM C 920, Grade NS.
   2. Sealant backer rod shall be closed-cell polyethylene foam.
   3. Joint design, surface preparation, and sealant primer shall be based on sealant manufacturer's recommendations and project conditions.

PART 3 – EXECUTION

3.1 INSTRUCTIONS

A. Compliance: Comply with manufacturer’s instructions for installation of base and finish coats.

3.2 INSPECTION

A. Substrate Examination: Examine prior to basecoat installation as follows:
   1. Substrate shall be examined for soundness, and/or other harmful conditions.
   2. Substrate shall be free of dust, dirt, efflorescence, and other harmful contaminants.
   3. Notify contractor of discrepancies preventing installation of the stucco assembly.

B. Verify that flashing is installed in compliance with requirements of applicable codes, regulations, and agencies having jurisdiction.
C. Verify that lath is tight, properly secured, and that all accessories are properly set.

D. Isolation: Where lath and metal support assembly abuts the building structure horizontally, and where partition wall work abuts the overhead structure, isolate work from structure movements. Install expansion or control joints to absorb deflections but maintain lateral support. Frame both sides of expansion and control joints separately and do not bridge joints with furring or lath.
E. Examine substrates, grounds, and accessories to ensure that finished stucco work will be true to line, plane, level and plumb.

3.3 PREPARATION OVER MASONRY SUBSTRATES: DIRECT BOND APPLICATIONS

A. Conform to preparation requirements of ASTM C926.
B. Verify that masonry and concrete surfaces to receive direct bond applications of stucco basecoats are rough, free from form release agents and otherwise properly prepared to provide for adequate bond.
C. Apply a uniform coating of the acrylic bonding agent in accordance with manufacturer's recommendations and instructions.

3.4 REPAIR AND PREPARATION OF EXISTING PLASTER

A. Rout all cracks in subject area shown on the drawings, or as otherwise directed by the Architect to their full depth; the width of the groove to be minimum 1/4".
B. Fill all cracks with Portland plaster finish coat material.
C. Mechanically abrade or sandblast the existing plaster stucco surfaces throughout the entire area to be resurfaced.
D. Dampen the surface to prevent absorption of excessive amount of water from new plaster coat application. The prepared surface shall be at, or slightly drier than, a saturated, surface-dry condition.
E. Verify that the surface of the stucco is rough, free from form release agents and otherwise properly prepared to provide for adequate bond.
F. Apply a uniform coating of the acrylic bonding agent in accordance with manufacturer's recommendations and instructions.

3.5 INSTALLATION

A. Apply stucco basecoat in accordance with manufacturer's instructions and recommendations as written in the manufacturer's data sheets, and in compliance with requirements of applicable codes, regulations and agencies having jurisdiction.
B. Interrupt stucco application only at junctions of stucco planes, at openings, at control joints or at expansion joints.
C. Basecoat:
    1. Apply scratch coat to a thickness of 3/8 inch using sufficient trowel pressure to key stucco into lath or onto direct bond substrate
    2. Scratch horizontally to provide for a key with the brown coat.
    3. Apply Brown coat after 4- hour curing over scratch coat to a thickness of 3/8 inch using sufficient trowel pressure or spray velocity to key brown coat into scratch coat.
    4. Darby, then rod surface to true plane.
    5. Float or lightly broom surface to provide bond with finish coat.
    6. Tool brown coat to provide a V-joint at intersection of stucco with frames or other items of metal, wood, or plastic that act as stucco grounds.

D. Finish Coat: Stucco Finish apply over basecoat and over prepared existing stucco.
    1. Apply exterior wall finish coat after 7 – 10 days to thickness recommended by manufacturer to achieve texture indicated, using sufficient trowel pressure or spray velocity to bond finish coat to basecoat.
    2. Apply exterior wall finish in number of coats and consistency required to achieve texture to match approved sample.

3. Fog Coat: As needed, apply sufficient coats to ensure uniform color and consistency. Let dry, then mist with water 2 times a day for 2 days.
4. Water Repellent: After stucco finish has fully cured for 28 days, apply water repellent by brush, roller, or spray at a rate that is recommended by manufacturer. Apply from corner to corner, starting at bottom and working to top.

3.6 CURING

A. Moist cure basecoat with a fog spray of clean water in sufficiently frequent applications to maintain stucco uniformly moist for a minimum of 48 hours following applications.
B. Moist cure finish coats a fog spray of clean water in sufficiently frequent applications to maintain stucco uniformly moist for a minimum of 48 hours following applications.

3.7 CLEANING

A. Patching: Repair damaged exterior wall finish coat to match surrounding finish.
B. Cleanup:
    1. Remove excess finish and protective materials from adjacent surfaces.
    2. Remove all excess materials from the project site.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this section includes:
   1. Metal stud wall furring and framing.
   2. Supply, installation, and finishing of gypsum board.

1.3 RELATED WORK

A. Building Insulation is Specified within Section 07 21 16.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with all requirements. Submit under the provisions set forth in Section 01 61 00.

1.5 JOB CONDITIONS

A. Maintain a uniform temperature of not less than 50 degrees F. in the structure for at least 48 hours prior to, during, and following the application of gypsum board and joint treatment materials.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Standard Wallboard: Unless otherwise indicated, all gypsum board shall be standard thick tapered-edge board, 48" wide in lengths as required to eliminate end-joint corners, conforming to ASTM C-1396, moisture-resistant gypsum board. Provide Type “X” fire-resistant gypsum board for fire partitions and ceiling assemblies at corridors.

B. Gypsum Ceiling: Unless otherwise indicated, all gypsum board shall be standard tapered-edge board, 5/8” Type-X Gypsum Board, 48" wide in lengths as required to eliminate end-joint corners, conforming to ASTM C-1396, moisture-resistant gypsum board.
   1. Ceiling Application: Gypsum Board must be capable of horizontal span of 24” O.C when installed to truss system.
   2. Fastening Pattern: Utilize 7” O.C. maximum fastener spacing at perimeter, and 12” maximum fastener spacing in field.

C. Steel studs, runners, furring and accessories: Fabricated from galvanized steel G60, complying with the following specifications:
   1. 3 5/8" web or as otherwise required by the drawings, 20-gauge studs with 1 3/8" flange and 5/16" return lip.
   2. Track: 3 5/8" web, or as otherwise required by the drawings or to match existing conditions, 20 gauges with 1 1/4" flange.

3. Wall furring: 18 gauge, 1 1/2" metal "Z" furring with 1 ¼" flange or 1 ½" depth hat channels with an A60 coating or equivalent. Refer to Partition Schedule on the Drawings. Use only Z furring at walls with rigid insulation.
4. Hanger Wire Galvanized hanger wire, 8 gauge.
5. Flat Straps: 2" x 20 gauge.
6. Tie Wire 18-gauge galvanized tie wire.

D. Fasteners:
1. Gypsum Board to Studs: Self-drilling Type "S" Phillips head drywall screws, hot-dipped galvanized 1 inch long for single layer; 1-5/8" long for double layer.

E. Accessories:
1. Corner Beads: Wallboard corner bead, galvanized 1-1/8" x 1-1/8" for crimped application for single layer application; 1-1/4" x 1-1/4" for double layer application.
2. Casing Beads: No. 200 galvanized for finishing with joint compound, except where otherwise shown or required.

F. Tapes and Compounds: Tape shall be standard reinforcing tape for all gypsum board, application as recommended by the gypsum board manufacturer, except at moisture-resistant wallboard at external corner applications, use "Multi-Flex" corner beads. Use tape at intersections of vertical gypsum wallboard and ceiling construction.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Wall Furring: Attach furring to exterior masonry with powder actuated fasteners. Obtain manufactures services to determine the type and spacing of fasteners to resist a system withdrawal force of 20 psf. Install furring at 24" on center. Install Gypsum board vertically or horizontally. Extend furring, insulation, and gypsum board from first floor slab to the top of the ceiling joists.

B. Stud System Erection: Attach steel runners at floor and ceiling to structural elements with suitable fasteners located 2" from each end and spaced 24" o.c. Position studs vertically, with open side facing in same direction, engaging floor and ceiling runners, and spaced 24" o.c. When necessary, splice studs with 8" nested lap and two positive attachments per stud flange. Place studs in direct contact with all door frame jambs, abutting partitions, partition corners and existing construction elements. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall surfaces. Anchor all studs for shelf-walls and those adjacent to door and window frames, partition intersections, corners and free-standing furring to ceiling and floor runner flanges with screws. Securely anchor studs to jamb and head anchors of door frames by bolt or screw attachment. Over metal door place horizontally a cut-to-length section of runner, with a web-flange bend at each end, and secure to strut-studs with two screws in each bent web. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over door frame header. When attaching studs to steel grid system, structural adequacy of grid to support end reaction of wall must be determined. All stud partitions which do not extent to the underside of the deck above must be diagonally braced at the top track to the deck above at a maximum of 32" on center utilizing studs of the same gauge and thickness.

C. Gypsum Panel Erection:
1. Vertical Surfaces: Apply gypsum panels (vertically or horizontally). Position all edges over studs for vertical application; all ends over studs for horizontal application. Use practical maximum lengths to minimize end joints. Fit ends and edges closely, but not forced together. Stagger joints on opposite side of partition. For single-layer vertical application of gypsum panels, space screws 12" on center in field of panels and 8" on center staggered along vertical abutting edges. For horizontal panel application, space screws 12" on center in field and along abutting end joints. Refer to specific requirements for firerated assemblies designated on drawings. Install Bullet Resistant Panels following manufacturer's installation instruction, in walls so indicated, prior to installation of gypsum board.

2. Ceiling Installation: Apply gypsum panels of maximum practical length with long dimension at right angles to framing. Position end joints over framing and stagger in adjacent rows. Fit ends and edges closely but not forced together. Fasten panels with adhesive and 1-5/8" type "S" screws spaced 12" on center in field and 7' on center maximum along supports.

D. Accessory Application
1. Joint System: Finish all face panel joints and internal angles with Joint System installed according to manufacturer's directions. Spot exposed fasteners on face layers and finish corner bead, control joints and trim as required, with at least three coats of joint compound, feathered out onto panel faces and sanded smooth.
2. Laminating Adhesive: Spread to provide 1/2" adhesive beads, 4-1/2" on center for full sheet lamination. For strip lamination, apply adhesive in vertical strips of four 1/2" beads 1-1/2" to 2" on center. Space strips 24" on center.
3. Corner Beads: Reinforce all vertical and horizontal exterior corners with corner beads fastened with 9/16" rosin coated staples 9" on center on both flanges along entire length of bead.
4. Metal Trim: Where assembly terminates against masonry or other dissimilar material, apply metal trim over panel edge and fasten with screws or 9/16" rosin coated staples 12" on center.
5. Screws: Power drive at least 1/8" from edges or ends of panels to provide uniform dimple 1/32" deep.

E. Joint Finishing
1. For joint treatment, use joint compound and topping compound confirming to ASTM C-475 as recommended by gypsum wallboard manufacturer. At acoustical type partitions, do not install joint finishing compound until all acoustical sealing has been completed. Joint and corner finishing at wallboard to wallboard joints and corners shall, in general, not cover or conceal acoustical sealant, except as may be otherwise specifically called for on the drawings.
2. At conventional joints, a uniform thin layer of joint compound approximately 4" wide shall be applied over each joint. Tape shall be centered over the joint and embedded continuously into the compound leaving sufficient compound under the tape to provide proper bond. Allow compound to dry thoroughly, a minimum of 24 hours between coats.
3. At internal corners, fold tape lengthwise through the middle and fit neatly into corner. Tape shall be covered with compound spread evenly over and slightly beyond the tapered edge of board and feathered at edges. When dry, cover the second coat of compound forming a smooth, uniform, slight crown over the joint, feathered slightly beyond preceding coat.
4. Dimples at screw heads shall receive three coats of compound.
5. Flanges of metal corner beads shall be concealed by at least two coats of compound, which when finished, shall extend approximately 8" from exposed nosing.
6. Each coat shall be sanded as necessary after compound has dried. Using topping compound for finishing coats. Final coat after sanding shall leave the gypsum wallboard and treated areas smooth with joints concealed from view in the finished work. Care shall be taken not to scuff the paper surface of the wallboard when sanding.
7. All edges and corners shall be left square, all surfaces plane, plumb, straight and true and ready for painting or other finish.
8. Tape all joints in wallboard.

F. Patching
1. Defects or damage in the gypsum wallboard surface shall be repaired or replaced before final surface treatments or painting operations are started. The resulting repaired area shall be flat, true and plumb with adjacent surfaces and shall have a smooth surface ready for decoration.
2. Patch all gypsum board work cut for work of other trades.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of metal suspension system components and acoustical ceiling panels (tiles).

1.3 REFERENCES

A. Comply with provisions of the latest editions of the following specifications and standards, except where more stringent requirements are shown or specified:
   1. ASTM C635 Metal Suspension Systems for Acoustical Tile and Lay-in Panels
   2. ASTM C636 Installation of Metal Suspension Systems for Acoustical Tile and Lay-in Panels
   3. ASTM E84 Surface Burning Characteristics of Building Materials.
   4. ASTM E580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint
   5. Underwriters Laboratories - “Fire Resistance Directory"

1.4 QUALITY ASSURANCE

A. FM Compliance: Class I, (Flame spread rating of 25 or less)
B. UL Classification: Maximum of 25 for flame spread, fuel contributed, and 50 smoke developed.

1.5 SUBMITTALS

A. Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

PART 2 – PRODUCTS

2.1 CEILING PANELS

A. TYPE 1: Cast Mineral Fiber Acoustical Panels (2’x 2’): Heavy textured units not less than 3/4" thick, fine line edge recessed exposed grid, non-directional texture, NRC 0.65, CAC 35 and LR .70. Tegular edge panels
   1. ASTM E1264 classification Type III, Form 4, Pattern F
   2. ASTM E84 surface burning characteristics Class A, Flame spread: 25, Smoke developed: 50

B. TYPE 2: Wet-formed ceramic and mineral fiber composite Acoustical Panels (2’x 2’ for toilet rooms): Fine fissured units not less than 5/8" thick, square edge lay in exposed grid, non-directional texture, NRC 0.55, CAC 38 and LR .82. Mold and Moisture resistant.
   1. Surface Finish: Scrubbable factory-applied plastic paint finish
   2. ASTM E1264 classification Type III, Form 4, Pattern F
   3. ASTM E84 surface burning characteristics Class A, Flame spread: 25, Smoke developed: 50

2.2 CEILING SUSPENSION MATERIALS

A. General: Comply with ASTM C 635, as applicable to type of suspension system required for type of ceiling units indicated. Coordinate with other work supported by or penetrating through ceilings, including light fixtures and HVAC equipment.
B. Structural Class: Intermediate-duty system.
C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table l, Direct Hung.
D. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, prestretched, yield-stress load of at least 3 times design load, but not less than 12 gauge (0.106").
E. Type of System: Direct-hung suspension system with Compression struts
F. Edge Molding: Manufacturer's standard channel molding for edges and penetrations of ceiling, with single flange of molding exposed, white baked enamel finish, unless otherwise indicated.
G. Exposed Suspension System: Heavy duty 15/16” type XL main beam and cross tee of type and profile specified with exposed cross-runners coped to lay flush with main runners.
    1. System shall have 18 gauge, hold down border clips.
    2. Fasteners shall be security screws.
    3. Compression struts
    4. Finish of Exposed Members: Provide uniform factory-applied finish or exposed surfaces of ceiling suspension system, including moldings, trim and accessories.
    5. Finish: Manufacturer's standard baked enamel finish, white unless otherwise selected by Architect.

H. Hidden Suspension System for Drywall: Heavy Duty tee 1 1/2” face width and cross tee of type and profile specified with drywall suspension system.
    1. Meets ASTM E580 tension and compression strength requirements for tee, cross tees and hangar wire connections when tested per ASTM C1925.
    2. Provide G40 hot-dipped galvanized steel or equivalent coating.
    3. System to comply with seismic design category as delineated on Drawings.

2.3 MISCELLANEOUS MATERIALS

A. Edge Trim Molding: Metal, of types and profiles indicated, white finish unless otherwise indicated.
B. Acoustical Sealant: Heavy-bodied, non-shrinking, non-drying, non-sag mastic compound intended for interior sealing of concealed construction joints.
C. Drywall Ceiling accessories:
    1. Use manufacturers standard clips in tight applications to provide strong deck support connection with the use of hangar wires.
    2. Drywall Grid Locking Channels: Manufacturer's standard channels with an engineered locking pocket for connecting tees to the perimeter of ceiling, without using fasteners.

PART 3 – EXECUTION

3.1 INSPECTION

A. Installer must examine conditions under which acoustical ceiling work is to be performed and must notify Contractor in writing of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
B. Field measure: Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders and comply with reflected ceiling plans wherever possible.

3.3 INSTALLATION

A. General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards acceptable to work.
B. Arrangement of units: Arrange acoustical units and orient directionally-patterned units (if any) in manner shown by reflected ceiling plans. Install tile with pattern running in one direction.
C. Suspension System: Replacement suspension system components shall match the existing in finish and profile. Install suspension system to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers near each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated leveling to tolerance of 1/8" in 12'-0".
D. Hanger wire: Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secured and appropriate for substrate, and which will not deteriorate or fall with age or elevated temperature.
E. Edge moldings: Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
    1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
    2. Screw-attach moldings to substrate at intervals not over 16" on center and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.

F. Installation of acoustical panels: Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
G. Install hold-down clips in all areas and space as recommended by panel manufacturer, unless otherwise indicated or required.
H. Install hangers and inserts coordinated with overhead work. Provide additional hangers and supports as required.
I. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:240.
J. Seismic Suspension System: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
K. Where ducts, facility services, or equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
L. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
M. Do not eccentrically load system or induce rotation of runners.
N. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 ADJUST AND CLEAN

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13
RESILIENT WALL BASE AND ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the supply and installation of resilient wall base, premolded rubber treads and risers, and molding accessories where scheduled on the drawings.

1.3 RELATED WORK:

A. Laminate Flooring is specified in Section 09 65 19.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.
   1. Armstrong World Industries, Inc.
   2. Azrock Commercial Flooring, DOMCO
   3. Burke Mercer Flooring Products
   4. Endura
   5. Roppe Corporation
   6. Or Approved Equal

B. Type (Material Requirement): TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
C. Style: Cove (with top-set toe or Straight (toeless).
   1. Height: 4 inches (6” where indicated on the drawings to match existing solid base to remain)
   2. Lengths: Coils in manufacturer's standard length. 4’-0” lengths are not acceptable.
      a. Outside Corners: Job formed or pre-molded
      b. Inside Corners: Job formed or pre-molded

D. Surface: Smooth.

2.3 RUBBER STAIR AND RISERS' TREADS:

A. Rubber stair tread and risers fabricated from 100% synthetic virgin rubber (SVR) with mineral aggregates, pigments and stabilizing agents equal to Activa one-piece nose-tread-riser premolded to fit treads with a square nose configuration full step.
B. Tread and Landing Adhesive: Chemrex CX-948 Contact Adhesive or approved equal.

2.4 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and
   1. substrate conditions indicated.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

3.2 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, and other permanent fixtures in rooms and areas where base is required.
B. Install wall base, from rolls, in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned. Installation of 4'-0" long strips is not acceptable.
C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
D. Do not stretch wall base during installation.
E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
F. Pre-molded Corners: Install pre-molded corners before installing straight pieces.
G. Job-Formed Corners: Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

END OF SECTION

SECTION 09 65 19
LAMINATE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.3 RELATED WORK:

A. Concrete is specified in Section 03 30 00
B. Joint Sealants are specified in Section 07 92 00

1.4 REFERENCES

A. Armstrong Flooring Technical Manuals
B. Armstrong Flooring Guaranteed Installation Systems manual, F-5061
C. ASTM International:
   1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
   2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
   3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
   4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
   5. ASTM F 1700 Standard Specification for Solid Vinyl Tile
   6. ASTM F 1861 Standard Specification for Resilient Wall Base
   7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
   8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

D. National Fire Protection Association (NFPA):
   1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
   2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

1.5 SYSTEM DESCRIPTION

A. Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.
B. Administrative Requirements
   1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.
   2. Pre-installation Testing: Conduct pre-installation moisture, pH, and bond testing.

C. Sequencing and Scheduling:
   1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
   2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.6 SUBMITTALS

A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
C. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
E. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
   2. Warranty: Warranty documents specified herein

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.
B. Fire Performance Characteristics: Provide resilient tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
   1. ASTM E 648 (NFPA 253) Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
   2. ASTM E 662 (NFPA 258) (Smoke Generation) Maximum Specific Optical Density of 450 or less

1.8 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
C. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.9 PROJECT CONDITIONS

A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65ºF and a maximum temperature of 85ºF for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55ºF in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Comply with manufacturer’s installation instructions.

1.10 LIMITED WARRANTY

A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
B. Limited Warranty Period: 20 years.
C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.11 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
   2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

PART 2 - PRODUCTS

2.1 RESILIENT TILE FLOORING MATERIALS

A. Provide Luxury Solid Vinyl Tile Flooring with a natural wood appearance.
   1. Description: A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
   2. Reference specification - ASTM F 1700, “Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
   3. Pattern and Color: Color selected from the range currently available from the flooring manufacturer.
   4. Size: 36 in. x 6 in. Panel sizes wider than 6” and/or shorter than 36” will not be accepted.
   5. Wear layer thickness: 0.020”
   6. Thickness: 1/8"/0.125 in.

2.2 ADHESIVES

A. Utilize adhesive as recommended by the flooring manufacturer for application of the approved flooring.

2.3 ACCESSORIES

A. For patching, smoothing, and leveling monolithic subfloors concrete, terrazzo, quarry tile, ceramic tile, and certain metals, provide Fast-Setting Cement-Based Patch and Underlayment.
B. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
C. Provide transition/reducing strips tapered to meet abutting materials.
D. Provide threshold of thickness and width as shown on the drawings.
E. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.

F. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish. Transitions shall comply with the requirements of the NJ Barrier-Free Subcode ICC/ANSI A117.1-2017.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).
B. Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates regarding conditions existing at the time of installation.

3.3 PREPARATION

A. Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Fast-Setting Cement-Based Patch and Underlayment or as otherwise recommended by the flooring manufacturer.
B. Subfloor Preparation Moisture Mitigation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control, or construction joints, mitigate moisture and other defects with Fast-Setting Cement-Based Patch and Underlayment or as recommended by the flooring manufacturer.
C. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material.
D. When using Adhesive, perform subfloor moisture testing in accordance with ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in-situ Probes and Bond Tests to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Internal relative humidity of the concrete shall not exceed 95%. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.

E. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained. Remove all paint, varnish, oil, and wax from all subfloors. Many buildings constructed before 1978 contain lead-based paint, which can pose a health hazard if not handled properly. State and federal regulations govern activities that disturb lead-based painted surfaces and may also require notice to building occupants. Do not remove or sand lead-based paint without consulting a qualified lead professional for guidance on lead-based paint testing and safety precautions. Armstrong Flooring does not recommend the use of solvents to remove paint, varnish, oil, wax or old adhesive residues because the solvents can remain in the subfloor and negatively affect the new installation. Whenever sanding, be certain the work site is well ventilated and avoid breathing dust. If high dust levels are anticipated, use appropriate National Institute for Occupational Safety and Health (NIOSH) designated dust respirator. All power sanding tools must be equipped with dust collectors. Avoid contact with skin or eyes. Wear gloves, eye protection, and long-sleeve, loose fitting clothes

F. For additional information on the installation and preparation of wood and board-type underlayments see the current edition of ASTM F1482, “Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.”

G. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring.

3.4 INSTALLATION OF FLOORING

A. Install flooring in strict accordance with the manufacturer’s installation instructions. Failure to comply may result in voiding the manufacturer’s warranty.

B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

C. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

D. Roll with a 100-pound roller in the field areas. Refer to specific rolling instructions of the flooring manufacturer.

E. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

3.5 INSTALLATION OF ACCESSORIES

A. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.

B. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

C. Apply overlap metal edge strips, where shown on the drawings, after flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.6 CLEANING

A. Perform initial and on-going maintenance according to the manufacturer’s instructions.

3.7 PROTECTION

A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

SECTION 09 67 19
DECORATIVE QUARTZ EPOXY FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes all labor, materials, equipment, and services necessary to complete epoxy flooring incorporating ceramic coated colored inorganic quartz aggregate and integral base as shown on drawings and/or specified herein.

1.3 RELATED WORK

A. Concrete – Section 03 30 00

1.4 SUBMITTALS

A. General: Submit the following in accordance with Section 01 61 00.
B. Product Data: Submit manufacturer's technical data application instructions and general recommendations for decorative quartz epoxy flooring specified herein.
C. Samples for initial selection purposes in form of manufacturer's color charts showing range of standard colors available. Submit 2 1/2" x 4" samples in color and quartz aggregate combination as selected.
D. Material certificates signed by manufacturer certifying that the decorative quartz epoxy flooring submitted complies with requirements specified herein.
E. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain epoxy component of flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer. Obtain ceramic-coated quartz aggregate from primary manufacturer of that product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels containing brand name and directions for storage and mixing with other components.
B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Comply with epoxy resin composition flooring manufacturer's directions for maintenance of ambient and substrate temperature, moisture, humidity, ventilation, and other conditions required to execute and protect the work.
B. Lighting: Permanent lighting will be in place and working before installing decorative quartz epoxy flooring.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Decorative quartz epoxy flooring shall be Sherwin Williams ResuFlor Screed Deco Quartz II, Dex-O-Tex Decor-Flor, Sika USA SikaFloor Decodur Quartz, Dur-A-Flex Dur-A-Quartz, or Approved Equal.

2.2 PROPERTIES

A. Colors: As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard color combinations.

B. Physical Properties: Provide flooring system that meets or exceeds the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.

1. Compressive Strength
2. Complete system (ASTM C-109) 8,556 psi
3. Resin Component (ASTM D-695) 12,900 psi
4. Surface Hardness (ASTM D-2240) Durometer D 85
5. Aggregate Hardness (Moh's Mineral Scale) 6 ½ - 7
6. Indentation Characteristics (MIL-D-3134 Para. 4.7.4.2.1-Steadily Applied Load) 0.005 indentation
7. Impact Resistance (MIL-D-3134) 0.011 indentation Para. (4.7.3) No cracking, loss of bond
8. Adhesion (ACI Comm. 503.1-92) 345 psi (100% failure in concrete)
9. Water Absorption (MIL-D-3134) Less than 1%
10. Abrasion Resistance (ASTM C-501) 19 Wear Index (H-22 Wheel)
11. Tensile Strength (ASTM D-638) 4,400 psi
12. Resin Component Elongation (ASTM D-638)19.6%

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where decorative quartz epoxy flooring is to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the Architect. Starting the installation constitutes acceptance of the substrate.

3.2 PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to flooring manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry, and neutral substrate for flooring application.

B. Concrete Surfaces: Shot-blast, acid etch, or power scarify as required to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface, free of laitance, glaze, efflorescence, and any bond-inhibiting curing compounds or form release agents. Remove grease, oil, and other penetrating contaminates. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.

C. Materials: Mix epoxy resin components when required and prepare materials according to flooring system manufacturer's instructions.

3.3 APPLICATION

A. General: Apply each component of decorative quartz epoxy flooring system according to manufacturer's directions to produce a uniform monolithic flooring surface of thickness indicated.

B. Broadcast Coats: Apply liberal application of clear epoxy resin mixture. Allow to self-level, broadcast (by hand or spray machine) ceramic coated quartz aggregate, allow to set to hardness, sweep off excess unbonded aggregate and repeat process to achieve total nominal thickness of 1/16" – 1/8".

C. Finish or Sealing Coats: After quartz filled broadcast coats have cured sufficiently, apply finish coats of type recommended by flooring manufacturer to produce finish matching approved submittal sample and in number of coats and spreading rates recommended by manufacturer.
   1. Finished floor shall be 1/16" – 1/8" thick, uniform in color and free of trowel marks.

D. Cove Base: Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise indicated. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

3.4 CURING PROTECTION AND CLEANING

A. Cure decorative quartz epoxy flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

END OF SECTION

SECTION 09 72 10
SANITARY WALL FINISH

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes all labor, materials and incidentals required for the installation of fiberglass reinforced plastic (FRP) panels and trim assemblies

1.3 QUALITY ASSURANCE

A. Provide panels and molding only from one manufacturer to ensure warranty and color harmonization of accessories.

1.4 SUBMITTALS

A. Two samples of each type of panel, each type of trim and fastener.
B. Shop Drawings: Indicate the location and dimension of joints and fastener attachments.
C. Installation Guide

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Package sheets on skids or pallets for shipment to project site.
B. Storage of Materials: Store sheets in a dry place at the project site.
C. Handling: Remove foreign matter from face of panel by use of a soft bristle brush, avoiding abrasive action.

1.6 PROJECT CONDITIONS

A. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.
B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
C. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Acceptable Panels: Class III (C) Interior Finish. Wall panels shall be Kemlite Glasbord P with Surfaseal, (fiberglass reinforced plastic panels) manufactured by Kemlite Company or equal by Lasco Panel Products, Glasteel, Inc., Marlite, or approved equal. Color to be as selected by Architect from manufacturer's standard colors. Panel thickness shall be nominal .09". Products shall meet or exceed the following properties:
   1. Flame spread of 200 or lower; Smoke Developed of 450 or lower per ASTM E-84 latest version.
   2. Barcol Hardness (scratch resistance) of 40 as per ASTM D-2583.
   3. Panels will exhibit no more than a 0.038% weight loss after a 25-cycle Taber Abrasion Test.

B. Division Bars, Corner Trim: Panel manufacturer's standard length extruded vinyl pieces; longest length possible – to eliminate end joints.
C. Harmonizing PVC (polyvinylchloride) moldings shall be as selected by Architect from manufacturers standard selection.
D. Sealant: Joints shall be sealed with a high quality silicone sealant in accordance with Section 07 92 00.
E. Fasteners: Non-corrosive drive rivets in harmonizing colors as selected by architect from manufacturers standard selection. Install in accordance with manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
B. Do not begin installation until backup surfaces are put into satisfactory condition.

3.2 APPLICATION

A. Do all cutting with carbide tipped saw blades or drill bits, or cut with snips.
B. Install panels with manufacturer's recommended gap for panel field and corner joints.
C. Fastener holes in the panels must be predrilled 1/8" oversize.
D. For trowel type and application of adhesive, follow adhesive manufacturer's recommendation.
E. Using products acceptable to manufacturer, install the FRP panel system in accordance with panel manufacturer's printed instructions.

3.3 CLEANING

A. Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.

END OF SECTION

SECTION 09 90 00
PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Scope: The work of this Section includes the preparation painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.
B. Work Not Included: The following categories of work are not included as part of field applied finish work, or are included in other sections of these specifications:
   1. Shop priming: Unless otherwise specified, shop priming of ferrous items is included under various sections for structural steel; miscellaneous metal, hollow metal work and similar items. Also for fabricated components such as architectural woodwork, wood casework, and shop fabricated or factory built mechanical and electrical equipment or accessories.
   2. Pre-finished or factory items: Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified for such items.
   3. Concealed surfaces: Unless otherwise indicated, painting is not required on surfaces in concealed areas and generally inaccessible areas, foundation spaces, furred areas, pipe spaces, duct shafts and the like.
   4. Finished metal surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials.
   5. Operating parts and labels: Moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sinkages, sensing devices, and motor and fan shafts will not require finish painting unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use. Provide MDS sheets for all products.

1.4 DELIVERY AND STORAGE

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following:
   1. Name and title of material
   2. Fed. Spec. number, if applicable
   3. Manufacturer's stock number and date of manufacturer
   4. Manufacturer's name
   5. Contents by volume, for major pigment and vehicle constituents
   6. Thinning instructions
   7. Application instructions
   8. Color name and number

1.5 JOB CONDITIONS

A. Environmental Conditions:
   1. Apply water based paints only when temperatures are between 50 and 90 degrees F., unless otherwise permitted by paint manufacturer's printed instructions.

2. Apply solvent thinned paints only when temperature of surface to be painted and surrounding air temperatures are between 45 and 95 degrees F., unless otherwise permitted by paint manufacturer's printed instructions.

B. Weather factors: Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and within temperature limits specified by manufacturer during application and drying periods.

PART 2 – PRODUCTS

2.1 COLORS AND FINISHES

A. General:
   1. Paint colors shall be as directed by Architect.
   2. Surfaces treatments and finishes shall be as scheduled.

B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated. Lead content in pigment is limited to contain not more than 0.5% lead, as lead metal based on the total non-volatile (dry film) of paint by weight.
C. Paint Coordination: Provide finish coats which are compatible with prime coats used. Provide barrier coats over incompatible primers and remove and reprime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.
D. Single Manufacturer: Provide undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

2.2 PROPRIETARY NAMES

A. Proprietary names: When used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
B. Federal Specifications: Are used to establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.
C. Substitutions: Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.
D. Utilize Finishes manufactured by the following manufacturers:
   1. Benjamin Moore and Company (BM)
   2. Sherwin Williams Company (SW)
   3. Pittsburgh Paint Company (PP)
   4. Samuel Cabots Inc. (SC)
   5. Or Approved Equal

2.3 MATERIALS

A. Interior Wall Board Primer: Odorless vinyl-acrylic latex primer sealer, equal to SW:ProMar 200 Zero VOC Interior Latex Primer
B. Interior Wall Board Finish: Acrylic Latex Satin, equal to SW: ProMar 200 HP Zero VOC Acrylic Egshel
C. Interior Metal Primer (galvanized): Acrylic Rust inhibitor Primer, equal to SW: Pro Industrial ProCryl Universal Primer
D. Interior Metal Finish: Acrylic Latex gloss, equal to SW: Pro Industrial Waterbased Alkyd Urethane Gloss
E. Exterior Metal Primer: Acrylic Latex primer, equal to SW DTM Acrylic Primer/Finish, B66W1
F. Exterior Metal Finish: Acrylic Latex gloss, equal to SW DTM Acrylic Coating, B66 Series
G. Masonry Surfaces Primer: Block Filler (Masonry) equal to SW Heavy-Duty Block Filler B42W46
H. Masonry Surfaces Wall Finish: SW A-100 Exterior Latex.

PART 3 – EXECUTION

3.1 INSPECTION

A. General: Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

B. Surface Conditions: Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified for each particular substrate condition.

1. Related work: Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.
2. Items not scheduled: Paint exposed surfaces whether or not colors are designated in "schedules" except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas. If color or finish is not designated, Architect will select these from standard colors available for materials systems specified.
3. Remove hardware and hardware accessories, machined surfaces, plates, lighting fixtures and similar in-place items not to be finished painted or, provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
4. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
5. Do not paint over any Code required labels, such as Underwriters' Laboratory, Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

B. Ferrous Metals: Clean ferrous surfaces which are not galvanized or shop coated, of oil, dirt, and loose mill scale and other foreign substances by solvent or mechanical cleaning.

C. Galvanized surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.4 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Apply additional coats when undercoats, stains or other conditions show through final coats of paint, until paint film is of uniform finish, color and appearance. Ensure that surfaces including, edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat before installation of equipment.
3. Finish interior doors on tops, bottoms, and side edges same as faces, unless otherwise indicated.
4. Sand lightly between each succeeding coat of enamel or varnish.

B. Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Allow sufficient time between coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause lifting or loss of adhesion of the undercoat.
C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or recommended by coating manufacturer.
D. Prime Coats: Apply prime coat of material which is required to be painted or finished and which has not been prime coated by others. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas.
E. Pigmented (opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, "holidays", spotting, laps, brush marks, runs, sags, and other surface imperfections will not be acceptable.

3.5 CLEAN-UP AND PROTECTION

A. Clean-up: During progress of work, remove from size discarded paint materials, rubbish, cans and rags at the end of each day's work. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scrapping. Use care not to scratch or damage finished surfaces.
B. Protection: Protect the work of other trades, whether to be painted or not., against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to the Architect and at no additional charge to the Owner.
C. Completion: At the completion of the work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6 COATING SCHEDULE

A. Refer to Article 2.3 above for materials
B. Wall Board: (Egg Shell Finish)
    1. Primer: 1 Coat Interior Primer
    2. Finish: 2 Top Coats Interior Wall Board Finish
    3. Total Dry Mils: 4.5 DFT

C. Galvanized Interior Metal
    1. Primer: 1 Coat Interior Metal Primer
    2. Finish: 2 Top Coats Interior Metal Finish
    3. Total Dry Mils: 7.5-13.0 DFT

D. Galvanized Interior Metal
    1. 1. Primer: 1 Coat Interior Metal Primer
    2. 2. Finish: 2 Top Coats Interior Metal Finish
    3. 3. Total Dry Mils: 7.5-13.0 DFT

E. Galvanized Exterior Metal
    1. Primer: 1 Coat Exterior Metal Primer
    2. Finish: 2 Top Coats Exterior Metal Finish
    3. Total Dry Mils: 7.5-13.0 DFT

F. Masonry Surfaces:
    1. Primer (Masonry): 1 Coat Block Filler (Masonry) equal to SW Heavy-Duty Block Filler B42W46
    2. Wall Finish (Masonry): 2 Coats SW A-100 Exterior Latex.

3.7 GUARANTEE

A. Refinish any areas where finishes have failed within one (1) year from date of acceptance by the Owner. Failure from vandalism, abnormal structural movement, or other causes not inherent in the finish system except normal wear and maintenance will not be considered failure of the finish.

3.8 PAINT FOR TOUCH-UP

A. Provide one (1) gallon of each type and color paint or finish used for touch-up.

END OF SECTION

SECTION 10 44 01
BUILDING IDENTIFICATION SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Instructions to Bidders and General Conditions, and Division One Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of interior signage.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required.
B. Samples: Submit samples of each sign form and material showing finishes, colors, surface textures and qualities of manufacture and design of each sign component including graphics. Acceptable units may be installed as part of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Room Identification, Informational, and Accessible Signage:
   1. Plaque: Face shall be 1/8” thick phenolic sheet with photopolymer fused to one side. Provide 1/8” Clear Lens with ADA Band, a thin photo etched plastic laminated to an area of the Clear Lens. Corners shall be square. Colors as selected by Architect.
   2. Mounting: Signs shall be surface mounted with vinyl tape.
   3. Graphics: Comply with ADA Accessibility Guidelines and ICC/ANSI A117.1-2009 requirements for Braille and lettering height and stroke. Font style shall be medium Helvetica. Provide Grade 2 Braille characters for all signage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Locate sign units and accessories where shown or scheduled.
   2. Mount interior signage plumb and level.
   3. Secure individual letters and directory signs to construction with stud mounting.
   4. Secure room identification and accessibility signage to construction with “very high bond” double-faced tape.
   5. Secure roof truss sign through siding and into substrate with stainless steel screws. Coordinate with Contractor for provision of adequate blocking.

3.2 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

END OF SECTION

SECTION 10 52 00
FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work under this Section includes the supply and installation of fire extinguishers and fire extinguisher cabinets section as specified herein and shown on the drawings.

1.3 QUALITY ASSURANCE

A. Single Manufacturer: Provide portable fire extinguishers, cabinets, and accessories by one manufacturer, unless otherwise acceptable to Architect.
B. UL-Listed Products: Provide new portable fire extinguishers which are UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Where color selections by Architect is required, include color charts showing full range of manufacturer's standard colors and designs available.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.
B. Abbreviations: Abbreviations below to identify extinguisher types related to UL classification and rating system and not, necessarily, to type and amount of extinguishing material contained in extinguisher. Multi-Purpose Dry Chemical Type, in enameled steel container for Class A, Class B, and Class C fires.
C. Provide 4-A:40B:C, 5 lb. fire extinguishers at each location indicated on plan.

2.2 FIRE EXTINGUISHER CABINETS

A. General: Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.
B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.
C. Semi-Recessed Cabinet: Provide semi-recessed cabinet where indicated on the drawings. Cabinet box (tub) semi-recessed in walls of sufficient depth to suit style of trim indicated. Surface mounted cabinets shall be provided at firerated partitions.
D. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

E. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180 degrees.

2.3 FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.
B. Preparation for Painted Finish: Clean surfaces of dirt, grease, and loose rust or mill scale. Apply finish to all surfaces of fabricated and assembled units, whether exposed or concealed when installed, except those surfaces specified to receive another finish.
C. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard baked enamel coating. Color to be selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
3. Where exact location of surface-mounted cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by Architect.

3.2 IDENTIFICATION

A. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk-screen process or through applied vinyl letters. Provide lettering on door as indicated, or if not indicated, as selected by Architect from manufacturer's standard letter sizes, styles, colors and layouts.

END OF SECTION

SECTION 10 80 00
TOILET ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including Instructions to Bidders, General and Supplementary Conditions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work required by this Section includes the supply and installation of toilet accessories as specified herein and shown on the drawings.

1.3 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.
B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units. Where a replacement unit is smaller than an existing accessory or device, provide a stainless-steel cover plate to cover existing mounting holes in wall finishes.
C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.
B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work.

PART 2 – PRODUCTS

2.1 PRODUCTS

A. Manufacturer: Lavatory accessories shall be as manufactured by Bobrick, Bradley, McKinney/Parker, or approved equal.

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gage minimum, unless otherwise indicated.
B. Brass: Leaded and unleaded, flat products, FS QQ-B 613; Rods, shapes, forgings, and flat products with finished edges, FS QQ-B-626.
C. Sheet Steel: Cold-rolled, commercial quality ASTM A 66, 20-gage minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
D. Galvanized Steel Sheet: ASTM A 527, G60.
E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
F. Mirror Glass: FS DD-G-451, Type I, Class 1, Quality q2, 1/4" thick tempered, with silver coating, copper protective coating, and non-metallic paint coating complying with FS DD-M-411.
G. Galvanized Steel Mounting Devices: ASTM A 386, hot-dip galvanized after fabrication.
H. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

2.3 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated; unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout Project. Furnish two keys for each lock.
B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Secure mirrors to walls in tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.
B. Concealed tamperproof fastening devices shall be used for attaching lavatory accessories. Provide steel reinforcement plates in wall for the secure attachment of all grab bars. These grab bars shall be installed in accordance with the manufacturer's recommendations and shall be capable of supporting the full weight of a large handicapped person. All toilet accessories to be installed level, plumb, and true.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation verifying that mechanisms function smoothly. Replace damaged or defective items.
B. Clean and polish all exposed surfaces after removing labels and protective coatings.
C. Clean exposed surfaces of mirror units in compliance with manufacturer's recommendations.

END OF SECTION

SECTION 21 00 00
FIRE PROTECTION SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
B. The requirements of all other sections of Division 21 apply to this section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 2 year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.
B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the fire protection work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
B. Contract: The Renovated Area is contractually required to be a Fully Sprinkled Building as defined by NFPA-13 2016 and current FM Global requirements for automatic sprinklers. The sprinkler system is to be installed with seismic hangers and restraints. Contractor is to study carefully review ALL Separate Disciplines (Architectural, Mechanical, Plumbing, Electrical etc).Contract Drawings to determine final head locations and amounts.
C. The following is a Summary of Contract Requirements (NOTE: This list is not all inclusive)

1. Remove all sprinkler piping & heads as shown for all building that is being renovated. All existing attic piping will need to be removed as the existing roof and attic is being removed and redone in the project. Sprinkler incoming service, dry system alarm check and small portion of the building that is remaining will remain existing as shown.
2. Provide all new dry sprinkler piping and heads to fully cover both renovated building & addition as per NFPA-13.
3. Reconnect all standpipe hoses and modify standpipe as shown to provide a new hose for the new bay.
4. Providing all necessary permits, approvals, fees, etc.
5. Provide instructions to the owner as outlined in these Specifications.
6. Provide all cutting and patching as required to perform the work of this contract.

7. Provide all necessary rigging as required to perform the work of this contract.
8. Provide manufacturer startup for all systems specified as outlined in these Specifications.
9. Provide removal of trash and general clean-up.
10. Provide as-built drawings.
11. Provide operation and maintenance manuals.
12. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
13. Completion Date: All Fire Protection work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

D. The sprinkler system is to remain active during construction, refer to construction drawings for detailed construction notes.

E. All new sprinkler piping shall be seismically braced. Refer to specification section 210548 for requirements.

F. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

G. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

H. All of the contract specifications and all of the contract drawings are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

I. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Electrical Mechanical, Plumbing and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

1.5 WARRANTY AND START-UP

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues a letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment; otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Owner shall include a two-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 21 specification sections.

END OF SECTION

SECTION 21 05 17
SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Advance Products & Systems, Inc.
   2. Metraflex Company (The).
   3. Pipeline Seal and Insulator, Inc.
   4. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
B. Characteristics: Non-shrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.

   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

   2. Interior Partitions:

      a. Piping Smaller Than NPS 4: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 21 05 18
ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.

h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.
D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 21 13 16
DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Pressure gages.

1.3 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.4 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

    a. Building Service Areas: Ordinary Hazard, Group 1.
    b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    c. General Storage Areas: Ordinary Hazard, Group 1.
    d. Laundries: Ordinary Hazard, Group 1.
    e. Machine Shops: Ordinary Hazard, Group 2.
    f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    g. Office and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
    a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
D. Qualification Data: For qualified Installer and professional engineer.
E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
G. Field quality-control reports.
H. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
C. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
D. Galvanized, Steel Couplings: ASTM A 865, threaded.
E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
F. Malleable- or Ductile-Iron Unions: UL 860.
G. Cast-Iron Flanges: ASME B16.1, Class 125.
H. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Anvil International, Inc.
        b. Shurjoint Piping Products.

I. Grooved-Joint, Steel-Pipe Appurtenances:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Anvil International
        b. Corcoran Piping System Co.
        c. National Fittings, Inc.
        d. Tyco Fire & Building Products LP.
        e. Victaulic Company.

    2. Pressure Rating: 175 psig minimum.
    3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

    4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free
    1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating: 175 psig .

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Kennedy Valve; a division of McWane, Inc.
   d. NIBCO INC.
   e. Potter Roemer.
   f. Tyco Fire & Building Products LP.
   g. Victaulic Company.
   h. Viking Corporation.
   i. Watts Water Technologies, Inc.

2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Hammond Valve.
   e. NIBCO INC.
   f. Tyco Fire & Building Products LP.
   g. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

D. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kennedy Valve; a division of McWane, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.

4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves.
      b. Kennedy Valve; a division of McWane, Inc.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Potter Roemer.
      f. Tyco Fire & Building Products LP.
      g. Victaulic Company.
      h. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Minimum Pressure Rating: 175 psig.
   3. Body Material: Cast or ductile iron.
   4. Size: Same as connected piping.
   5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Globe Fire Sprinkler Corporation.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Venus Fire Protection Ltd.
      e. Victaulic Company.

f. Viking Corporation.

2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air Compressor:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.

   b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.
B. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Shurjoint Piping Products.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.

   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Reliable Automatic Sprinkler Co., Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.

   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
   1. Nonresidential Applications: UL 199.
   2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:
   1. Chrome plated.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

F. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.

   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AMETEK, Inc.; U.S. Gauge Division.
   2. Ashcroft, Inc.
   3. Brecco Corporation.

B. Standard: UL 393.
C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
D. Pressure Gage Range: 0 to 250 psig minimum.
E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to existing sprinkler piping as indicated on the drawings.
B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.
C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.
D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
H. Install sprinkler piping with drains for complete system drainage.
I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.
K. Install alarm devices in piping systems.
L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.
M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
N. Drain dry-pipe sprinkler piping.
O. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance device air compressor.
P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."
Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    a. Install air compressor and compressed-air supply piping.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

D. Install sprinkler heads in existing and new stair towers.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.
B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.
C. Dry-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be the following:
   1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers, as indicated.
   3. Wall Mounting: Dry sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright sprinklers.
   5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Upright, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 220000
SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 2-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.
B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

A. The following description of work will use the following abbreviations:
   1. General Contractor – GC
   2. Electrical Contractor – EC
   3. Mechanical Contractor (HVAC) – MC
   4. Plumbing Contractor – PC

B. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the mechanical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
   1. Remove plumbing fixtures, including but not limited to, domestic water piping up to points as shown, sanitary waste piping up to points as shown, and supports.
   2. Remove all compressed air piping in the attic that is to be removed for the renovation back to point as indicated, including but not limited to, hangers and supports. Existing hose reels to be salvaged and will be reinstalled.
   3. Remove all gas piping in the attic that is to be removed for the renovation back to point as indicated, including but not limited to, hangers and supports.
   4. Remove all domestic water piping in the attic that is to be removed for the renovation back to service as indicated, including but not limited to, insulation, valves, specialties, hangers and supports.
   5. Provide and install all new fixtures in renovation as shown on contract drawings, including but not limited to, all new sanitary waste piping, domestic water piping, insulation, valves, specialties, hangers and supports.

6. Provide and install new compressed air piping in renovation and new addition as shown on contract drawings.
7. Provide and install all natural gas piping and appurtenances for gas fired equipment as indicated on drawings.
8. Provide and install new tankless water heater as detailed in contract drawings.
9. Provide and install all required hangers to install new piping as per specifications sections that follow.
10. Providing all necessary permits, approvals, fees, etc.
11. Provide instructions to the owner as outlined in these Specifications.
12. Provide all cutting and patching as required to perform the work of this contract.
13. Provide all necessary rigging as required to perform the work of this contract.
14. Provide manufacturer startup for all systems specified as outlined in these Specifications.
15. Provide removal of trash and general clean-up.
16. Provide as-built drawings.
17. Provide operation and maintenance manuals.
18. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
19. Completion Date: All plumbing work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

C. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

D. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

E. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Mechanical, Electrical and Plumbing) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

F. Coordination Between Electrical (EC) and Plumbing (PC) Contractors:

1. The Electrical Contractor shall:
    a. Receive and set the motor starters as provide by the Plumbing Contractors.
    b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
    c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
    d. Adjust connections to electrical motors to insure proper rotation.
    e. Provide 120V to junction boxes for the PC provided low-voltage 120-24V transformers. EC to receive the transformer from the PC and install & wire the transformer. EC shall install conduit in walls for all 24V powered plumbing fixtures – conduits shall be routed to backbox to above the finished ceiling from back boxes for each plumbing fixture. Coordinate with PC.

2. The Plumbing Contractor will:
    a. Furnish and set all motors for plumbing equipment.
    b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
    c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
    d. Provide and install 120V to 24V control power transformers for the electronic sensors

associated with the Water Closets, Lavatories and Urinals. PC shall provide and install all 24V wiring from the transformers to all fixtures. EC will only provide 120V connection to the transformer and empty conduit in wall for 24V wiring by PC.

3. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Owner shall include a two-year warranty on parts and labor. This warranty shall supercede all notations in all the other Division 22 specification sections.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 220500
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   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.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Available Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.

   2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
   3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
   4. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Available Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.

e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
1. Available Manufacturers:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Available Manufacturers:
a. Calpico, Inc.
b. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Available Manufacturers:
a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
E. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. 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.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
    1. New Piping:
        a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
        b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
        c. Insulated Piping: One-piece, stamped-steel type with spring clips.
        d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
        e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
        f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
        g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
        h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
        i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
        j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
        k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
        l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
    2. Existing Piping: Use the following:
        a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
        b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
        c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
        d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
        e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.

h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Permanent sleeves are not required for holes formed by removable PE sleeves.
O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
T. Verify final equipment locations for roughing-in.
U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

END OF SECTION

SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal fittings.
4. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Or approved equal.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.
6. Or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Firestops and Smokeseals."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Firestops and Smokeseals."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 220518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.
   2. Iron, single-flange butterfly valves.
   3. Iron, grooved-end butterfly valves.
   4. Bronze swing check valves.

B. Related Sections:
   1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. RS: Rising stem.
F. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set ball and plug valves open to minimize exposure of functional surfaces.
   4. Set butterfly valves closed or slightly open.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   2. Butterfly Valves: With extended neck.

F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.

   3. Solder Joint: With sockets according to ASME B16.18.
   4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves.

b. Crane Co.; Crane Valve Group; Crane Valves.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Legend Valve.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.; Apollo Valves.
b. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Legend Valve.
f. Milwaukee Valve Company.
g. Mueller Steam Specialty; a division of SPX Corporation.
h. NIBCO INC.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.4 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Milwaukee Valve Company.
e. NIBCO INC.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly valves.
   2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
   3. Throttling Service: Ball or butterfly valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

   2. Ball Valves: Two piece, full port, bronze with stainless-steel ball and trim.

B. Pipe NPS 3 and Larger:
   1. Iron Valves, NPS 3 to NPS 4: May be provided with threaded ends instead of flanged ends.

   2. Iron Ball Valves: Class 150.

   3. Iron, Single-Flange Butterfly Valves: 200 CWP, stainless-steel disc.

   4. Iron Swing Check Valves: Class 250, metal seats.

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   3. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. B-Line Systems, Inc.; a division of Cooper Industries.
   3. ERICO/Michigan Hanger Co.
   4. Grinnell Corp.
   5. GS Metals Corp.
   6. National Pipe Hanger Corporation.
   7. PHD Manufacturing, Inc.
   8. PHS Industries, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Available Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.

3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Value Engineered Products, Inc.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 6, to allow off-center closure for hanger installation before pipe erection.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 6.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 6.
6. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 6, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 6, from single rod if horizontal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 6, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
9. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 6, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
10. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 6, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 6.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 6, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
11. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
N. Use powder-actuated fastener or mechanical-expansion anchors instead of building attachments where required in concrete construction.
O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:

    a. Background Color: Green.
    b. Letter Color: White.

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Black.
    b. Letter Color: White.

3. Natural Gas Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches round.
   b. Hot Water: 1-1/2 inches round.

2. Valve-Tag Color:

   a. Cold Water: Natural.
   b. Hot Water: Natural.

3. Letter Color:

   a. Cold Water: White.
   b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic hot-water recirculation piping.
4. Sanitary waste piping.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.4 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

b. Or approved equal.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGuire Manufacturing.
b. Plumberex.
c. Truebro; a brand of IPS Corporation.
d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
e. Or approved equal.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Water and Hot Water Recirculation:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Field Applied Jacket: PVC P-Trap and supply covers.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Specialty valves.
2. Flexible connectors.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Domestic water piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than three days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Owner's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.
4) Or approved equal.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
d. Zurn Plumbing Products Group; Wilkins Water Control Products.
e. Or approved equal.

2. Description:

a. Pressure Rating: 150 psig .
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Calpico, Inc.
b. Lochinvar Corporation.
c. Or approved equal.

2. Description:

a. Galvanized-steel coupling.

b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

D. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.
d. Or approved equal.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Metraflex, Inc.
6. Unaflex, Inc.
7. Or approved equal.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

G. Install piping adjacent to equipment and specialties to allow service and maintenance.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) cast- or wrought- copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated water mixing valves.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.
e. Or approved equal.

B. Hose-Connection Vacuum Breakers

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. MIFAB, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Woodford Manufacturing Company.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Or approved equal.

C. Pressure Vacuum Breakers

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Watts Industries, Inc.; Water Products Div.
e. Zurn Plumbing Products Group; Wilkins Div.
f. Or approved equal.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers to be installed at incoming domestic water service and at any branch lines to mechanical equipment.

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.

4. Size: Varies.
5. Design Flow Rate: Varies
6. Selected Unit Flow Range Limits: Varies.
7. Pressure Loss at Design Flow Rate: 15 psig for sizes NPS 2 and smaller; 15 psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufactures: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.
    f. Or approved equal.

2.3 BALANCING VALVE

A. Copper Alloy Calibrated Balancing Valve

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. ITT Industries; Bell & Gossett Div.
    c. NIBCO INC.
    d. TAC Americas.
    e. Taco, Inc.
    f. Watts Industries, Inc.; Water Products Div.
    g. Or approved equal.

B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Conbraco Industries, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. Or approved equal.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Provide Powers model LFMM431 or an engineer approved equal from one of the following:

   a. Armstrong International, Inc.
   b. Leonard Valve Company.
   c. Symmons Industries, Inc.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.
   f. Or approved equal.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.

9. Tempered-Water Design Flow Rate: 15 gpm.
10. Valve Finish: Rough bronze.

2.5 WALL HYDRANTS

A. Non-freeze Wall Hydrants

1. Available Manufacturers: Provide model noted on plumbing schedules or an engineer approved equal by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Prier Products, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Zurn Plumbing Products Group; Light Commercial Operation.
   f. Or approved equal.

2.6 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Size: 1-1/2 NPS.
4. Design Flow Rate: 50 gpm .
5. Design Inlet Pressure: 100 psig.
6. Design Outlet Pressure Setting: 55 psig.
7. Body: Bronze for NPS 2 and smaller.
8. End Connections: Threaded for NPS 2 and smaller.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. StrainersNPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. MIFAB, Inc.
    c. PPP Inc.
    d. Sioux Chief Manufacturing Company, Inc.
    e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
    h. Or approved equal.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Or approved equal.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

A. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe Material Couplings: Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small differences in OD.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4: 60 inches with 5/8-inch rod.

E. Install supports for vertical cast-iron soil piping every 15 feet.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sewage Pumps: To sewage pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. Sioux Chief Manufacturing Company, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Light Commercial Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.

9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Or approved equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains (FD-A):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2005Y-02-A-05NB-Q45 or a comparable product by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.

7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.

10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 5 inch diameter.
16. Top Loading Classification: Light Duty.
17. Funnel: Not required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep Seal P-trap.
21. Trap Features: Pro-Set Trap Guard.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
   c. Or approved equal.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-, 0.0938-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ProSet Systems Inc.

   b. Or approved equal.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

I. Assemble open drain fittings and install with top of hub 1 inch above floor.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 33
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.
   6. Mechanical sleeve seals.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
   2. Service Regulators: 100 psig minimum unless otherwise indicated.

   3. Minimum Operating Pressure of Service Meter: As required by utility company specifications.

B. Natural-Gas System Pressures within Buildings: Primary pressure is 1.5 psig or less.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators. Indicate pressure ratings and capacities.

5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings.
6. Dielectric fittings.
7. Mechanical sleeve seals.
8. Escutcheons.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 1/4 inch per foot.

   2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
D. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
E. Qualification Data: For qualified professional engineer.
F. Welding certificates.
G. Field quality-control reports.
H. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
   1. Notify Owner no fewer than five days in advance of proposed interruption of natural-gas service.
   2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.
B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

   5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
      a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. PE Pipe: ASTM D 2513, SDR 11.

   1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
   2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

   3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
      a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
      b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
      c. Aboveground Portion: PE transition fitting.
      d. Outlet shall be threaded or suitable for welded connection.
      e. Tracer wire connection.
      f. Ultraviolet shield.
      g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

   4. Transition Service-Line Risers: Factory fabricated and leak tested.
      a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
      b. Outlet shall be threaded or suitable for welded connection.
      c. Bridging sleeve over mechanical coupling.
      d. Factory-connected anode.

e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.
B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig .
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig .
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      b. Conbraco Industries, Inc.; Apollo Div.
      c. Lyall, R. W. & Company, Inc.
      d. McDonald, A. Y. Mfg. Co.
   2. Body: Bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   8. CWP Rating: 600 psig.
   9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Flowserve.
      b. Homestead Valve; a division of Olson Technologies, Inc.
      c. McDonald, A. Y. Mfg. Co.
      d. Milliken Valve Company.
      e. Mueller Co.; Gas Products Div.
      f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
   2. Body: Cast iron, complying with ASTM A 126, Class B.
   3. Plug: Bronze or nickel-plated cast iron.
   4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   d. Invensys.
   e. Maxitrol Company.
   f. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Canadian Meter Company Inc.
b. Eaton Corporation; Controls Div.
c. Harper Wyman Co.
d. Maxitrol Company.
e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   d. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.8 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.9 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
B. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

C. Split-Plate, Stamped-Steel Escutcheons: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
D. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.11 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe.

D. Install fittings for changes in direction and branch connections.

E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

F. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

H. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern typRetain one of first two subparagraphs below.
      b. Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      c. Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
      d. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

e. Piping in Equipment Rooms: One-piece, cast-brass type.
f. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
M. Verify final equipment locations for roughing-in.
N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.

3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:
a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
T. Connect branch piping from top or side of horizontal piping.
U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
V. Do not use natural-gas piping as grounding electrode.
W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter per utility company requirements.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
B. Install underground valves with valve boxes.
C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.
B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel flat.
      d. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.14 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:
   1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be the following:
   1. Steel pipe with malleable-iron fittings and threaded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

END OF SECTION

SECTION 221513
GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig and less.
B. Related Sections include the following:
   1. Division 15 Section "Meters and Gages" for thermometers and pressure gages.
   2. Division 15 Section "General-Service Compressed-Air Equipment" for compressed-air equipment and accessories.

1.3 DEFINITIONS

A. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 125 and 200 psig.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Pipes, tubes, and fittings.
   2. Flexible pipe connectors.
   3. Safety valves.
   4. Pressure regulators.
   5. Filters.
   6. Automatic drain valves.
   7. Quick couplings.
   8. Hose assemblies.

B. Coordination Drawings: For general-service compressed-air systems. Include relationship to other services that serve same work area.
C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.
D. Welding Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX.
E. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
C. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L, seamless, drawn-temper, water tube.
   1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
C. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
   1. Manufacturers:
      a. Flex-Hose Co., Inc.
      b. Hyspan Precision Products, Inc.
      c. Metraflex, Inc.

   2. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
      a. Working-Pressure Rating: 200 psig minimum.
      b. End Connections NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.

2.4 JOINING MATERIALS

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.

2.5 VALVES

A. General-Duty Valves: Refer to Division 15 Section "Valves" for metal ball, butterfly and check general-duty valves.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.
   1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Line Pressure Regulators: Aluminum alloy, diaphragm operated, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure.

C. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters in sizes and ratings indicated. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.

D. Automatic Drain Valves: Corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

E. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
   1. Manufacturers:
      a. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
      b. Schrader-Bridgeport; Amflo Div.
      c. Schrader-Bridgeport/Standard Thomson.
      d. Tuthill Corporation; Hansen Coupling Div.

   2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
      a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

      b. Plug End: Straight-through type with serrated outlet for attaching hose.

   3. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.
      a. Socket End: With O-ring or gasket seal, without valve, and with serrated inlet for attaching hose.
      b. Plug End: With serrated outlet for attaching hose.

F. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure.

   1. Hose: Reinforced double-wire-braid, CR-covered hose for compressed-air service.
   2. Hose Clamps: Stainless-steel clamps or bands.

   3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.
   4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with serrated ends for connecting two sections of hose.

2.7 IDENTIFICATION

A. Refer to Division 15 Section "Mechanical Identification" for identification of piping, valves, gages, and specialties.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Install nipples, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below.
B. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fitting types.
   1. NPS 2 and Smaller: Dielectric unions.

C. Use metal general-service compressed-air piping between air compressors and air receivers.
D. High Pressure Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:
   1. NPS 2 and Smaller: Type K, copper tube; wrought-copper fittings; and soldered joints. Solder materials to be ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Compressed-Air Distribution Piping: Use the following piping materials for each size range:
   1. NPS 2 and Smaller: Type L, copper tube; wrought-copper fittings; and soldered joints. Solder materials to be ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

3.2 VALVE APPLICATIONS

A. General-Duty Valves: Refer to Division 15 Section "Valves" for metal general-duty valves. Use metal valves, unless otherwise indicated.
   1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 15 Section "Valves" according to the following:
      a. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
      b. Equipment Isolation NPS 2 and Smaller: Safety-exhaust copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.3 PIPING INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
B. Install air and drain piping with 1 percent slope downward in direction of airflow.
C. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
D. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
E. Install flexible pipe connector on each connection to air compressors.
F. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver; install according to Division 15 Section "Meters and Gages."
G. Install pipe expansion joints and anchors according to Division 15 Section "Pipe Expansion Fittings and Loops."

3.4 VALVE INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.
B. Install metal general-duty valves according to Division 15 Section "Valves."
C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories.

D. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.
E. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
F. Install automatic drain valves on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate to nearest floor drain.
G. Install safety valves where recommended by specialty manufacturers.

3.5 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
B. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.6 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 15 Section "Mechanical Vibration and Seismic Controls" for seismic-restraint devices.
B. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
      b. Longer Than 100 Feet : MSS Type 43, adjustable, roller hangers.
   3. Base of Vertical Piping: MSS Type 52, spring hangers.
C. Install supports according to Division 15 Section "Hangers and Supports."
D. Support horizontal piping within 12 inches of each fitting and coupling.
E. Support vertical piping at base and at each floor.
F. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
   2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
   3. NPS 1-1/2: 12 feet with 3/8-inch rod.
   4. NPS 2: 13 feet with 3/8-inch rod.
G. Install supports for vertical, Schedule 40, steel piping every 15 feet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to specialties and equipment to allow service and maintenance.
C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.8 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 15 Section "Mechanical Identification" for labeling and identification materials.

3.9 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
   2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
      a. Repair leaks and retest until no leaks exist.

   3. Report results in writing.

END OF SECTION

SECTION 22 34 00
FUEL FIRE DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fuel-fired water heaters:

1. Gas-fired, tankless, domestic-water heaters.
2. Compression tanks.
3. Water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of gas-fired, tankless, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASHRAE/IESNA 90.1-2004Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

E. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Gas-Fired, Tankless, Domestic-Water Heaters:

1) Heating Elements: Fifteen years.
2) Controls and Other Components: Five years.

b. Compression Tanks: Two year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide basis of design product as listed in the Domestic Hot Water Heater Schedule on drawing P4.1 or an engineer approved product by one of the available manufacturers.
a. A.O. Smith Corporation
b. Bradford White Corporation
c. Rheem Manufacturing Company

2.2 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS

A. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for indoor application.

B. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.

1. Tappings: ASME B1.20.1 pipe thread.
2. Pressure Rating: 150 psig.

3. Heat Exchanger: Primary Copper tubing with Secondary Stainless steel.
4. Insulation: Comply with ASHRAE/IES 90.1
5. Jacket: Metal, with enameled finish, or plastic.
6. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.

7. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
8. Temperature Control: Adjustable thermostat.

C. Support: Bracket for wall mounting.

D. Capacity and Characteristics:

1. Refer to schedule in contract drawings for all water heater data.

2.3 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:

a. AMTROL Inc.
b. Armstrong Pumps, Inc.
c. Watts Regulator Co.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.
d. ASME Construction: Required.

3. Capacity and Characteristics:

a. Working-Pressure Rating: 150 psig.
b. Capacity Acceptable: See hot water heater details compression tanks.

2.4 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

E. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004 or ASHRAE 90.2-2004.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

~~K.~~ Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. ~~Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.~~

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Fill water heaters with water.

O. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 224000
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets lavatories.
2. Laminar-flow faucet-spout outlets.
3. Toilet seats.
4. Fixture supports.
5. Water closets.
6. Lavatories.
7. Mop Receptors.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

D. PVC: Polyvinyl chloride plastic.

E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Plastic Mop-Service Basins: ANSI Z124.6.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucets: ASME A112.18.1.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Potable-Water Materials: NSF 61.
8. Pipe Threads: ASME B1.20.1.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures of unit shell.
   b. Faulty operation of controls, blowers, pumps, heaters, and timers.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 10 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Or approved equal.

B. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.2 WATER CLOSETS (P-1)

A. Water Closet:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

   a. Kohler Co.
   b. TOTO USA, Inc.
   c. Zurn, Inc.
   d. American Standard Companies, Inc.
   e. Or approved equal.

2. Description: See plans

2.3 LAVATORY (P-2)

A. Lavatory:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

   a. American Standard Companies, Inc.
   b. Briggs Plumbing Products, Inc.
   c. Crane Plumbing, L.L.C./Fiat Products.
   d. Kohler Co.
   e. Or approved equal.

2. ADA Covers: Plumberex Pro-Extreme pipe covers, complete with p-trap cover and supply and valve covers.

2.4 SINK (P-3)

A. Sinks:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:

a. Elkay Manufacturing Co.
b. Just Manufacturing Company.
c. Kohler Co.
d. Or approved equal.

2. Description: See plans

2.5 Service Sink (P-5)

A. Mop Receptor:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
a. Mustee.
b. Or approved equal.

2.6 SHOWER (P-4)

A. Mop Receptor:

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
a. Powers.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. LASCO Bathware.
e. American Standard.
f. Speakman, Inc.
g. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

I. Install toilet seats on water closets.

J. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

K. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

L. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

N. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

O. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 230000
SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
B. The requirements of all other sections of Division 23 apply to this section.

1.2 DEFINITIONS

A. Provide: Means to furnish, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.3 SUMMARY

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary to complete the installation of the work as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
   1. Remove all HVAC equipment from area of renovation, including any duct, piping, and control wiring that run in attic that is to be removed as part of the demolition.
   2. Remove unit heaters in their entirety, including but not limited to, exhaust flues, hangers, supports, controls and wiring as shown on contract drawings.
   3. Remove air filtration units in their entirety, including but not limited to, hangers, supports, controls and wiring as shown on contract drawings.
   4. Remove bathroom exhaust in its entirety, including but not limited to, ductwork, hangers, supports, controls and wiring as shown on contract drawings.
   5. Remove meeting room split AC unit in its entirety, including but not limited to, outdoor condensing unit, indoor wall hung air handling unit, refrigerant piping, condensate drain piping, equipment pads, insulation, hangers, supports, controls and wiring as shown on contract drawings.
   6. Provide and install new rooftop units, including but not limited to, supply & return ductwork, diffusers, grilles, air duct accessories, insulation, hangers, supports, controls and wiring as shown on contract drawings.
   7. Provide and install new office split AC unit, including but not limited to, outdoor condensing unit, indoor ceiling cassette unit, refrigerant piping, condensate drain piping, equipment rails, insulation, hangers, supports, controls and wiring as shown on contract drawings
   8. Provide and install new exhaust fans, including but not limited to, exhaust ductwork, grilles, air duct accessories, hangers, supports, controls and wiring as shown on contract drawings. Bay exhaust fans will have associated outdoor air louver with motorized damper.
   9. Provide and install new ceiling fans in the bays as shown on contract drawings.

10. Under alternate bid: Provide and install new infrared heaters in the bays, including but not limited to, combustion air duct, exhaust flue duct, flue terminations, hangers, supports, controls and wiring as shown on contract drawings.
11. Provide testing, adjusting and balancing for entire HVAC Systems. Entire HVAC Systems to include any new or existing HVAC equipment shown on contract drawings.
12. Provide all work noted in all of the specifications and drawings.
13. Provide all cutting and patching as required to perform the work of this contract.
14. Provide all necessary permits and approvals.
15. Provide all necessary rigging as required to perform the work of this contract.
16. Provide operation and maintenance manuals and record as-built drawings for everything installed in this contract.
17. Provide instructions and factory authorized training to owner of all equipment provided in this contract.
18. Provide cleanup and removal of all construction debris and other trash on a daily basis.

B. Note that this Summary of Work specification is intended to help delineate work. It does not mean that this is necessarily all of the work. It is ultimately the responsibility of the Contractor and their subcontractors to look at all the Contract Documents and all field conditions to determine the full extent of work for this project.

C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the work as indicated, required or implied by the drawings and as specified herein.

E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings, other documents and specification divisions to determine the full scope of his work.

F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Mechanical, Plumbing, Fire Protection and Electrical) and contract documents to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

G. Coordination between the Mechanical Contractor and Electrical Contractor:
   1. The Electrical Contractor shall:
      a. Receive and set the motor starters, etc. as provided by the Mechanical Contractor.
      b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
      c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
      d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
      e. Adjust connections to electrical motors to insure proper rotation.

   2. The Mechanical Contractor will:
      a. Furnish and set all motors for equipment provided as part of the HVAC contract.
      b. Furnish all motor starters, variable frequency drives, contactors, pushbuttons and switches for local and remote control of HVAC equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
      c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strip.

d. Furnish wiring diagrams for the systems power wiring, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Engineer issues his letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Owner shall include a one-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 23 specification sections that are shorter than two years. This warranty shall not supersede any warranty period that is longer than the years noted.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.
   3. Grout.
   4. HVAC demolition.
   5. Equipment installation requirements common to equipment sections.
   6. Painting and finishing.
   7. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PE: Polyethylene plastic.
   3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.

4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   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.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

2.3 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.4 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. 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.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
    1. New Piping:
        a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
        b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
        c. Insulated Piping: One-piece, stamped-steel type with spring clips.
        d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
        e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
        f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
        g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
        h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Permanent sleeves are not required for holes formed by removable PE sleeves.
O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
    1. Cut sleeves to length for mounting flush with both surfaces.
        a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
    2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
        a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
        b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
        c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
            1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
S. Verify final equipment locations for roughing-in.
T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

   3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

END OF SECTION

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.
F. Rotor: Random-wound, squirrel cage.
G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
H. Temperature Rise: Match insulation rating.
I. Insulation: Class F.
J. Code Letter Designation:
   1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Electronically commutated
   3. Split phase.
   4. Capacitor start, inductor run.
   5. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, electronically commutated.
C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:
1. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
   6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
   2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube and Conduit.
      b. B-line.
      c. Unistrut.
      d. Or approved equal.

   2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
   3. Standard: MFMA-4.
   4. Channels: Continuous slotted steel channel with inturned lips.
   5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Metallic Coating: Electroplated zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. National Pipe Hanger Corporation.
   2. Pipe Shields, Inc.
   3. Piping Technology and Products, Inc.
   4. Or approved equal.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

C. All fasteners exposed to resident access shall be security type Torx with center pin.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Plastic.
   3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

   1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
J. Install lateral bracing with pipe hangers and supports to prevent swaying.
K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
N. Insulated Piping:
    1. Attach clamps and spacers to piping.
        a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
        b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
        c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

    2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
        a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

    3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
        a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

    4. Shield Dimensions for Pipe: Not less than the following:
        a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
        b. NPS 4: 12 inches long and 0.06 inch thick.

    5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
    1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    2. Obtain fusion without undercut or overlap.
    3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
G. Use padded hangers for piping that is subject to scratching.
H. Use thermal-hanger shield inserts for insulated piping and tubing.
I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   7. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
   9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
   10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
   11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
   12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
      b. Medium (MSS Type 32): 1500 lb.
      c. Heavy (MSS Type 33): 3000 lb.

   13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
   15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Seton Identification Products.
      b. Marking Services, Inc.
      c. LEM Products, Inc.
   2. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   3. Letter Color: White.
   4. Background Color: Black.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Seton Identification Products.
   b. Marking Services, Inc.
   c. LEM Products, Inc.
   d. Or approved equal.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

E. Provide and install new adhesive clear labels with black text on the underside of the ceiling grid for all new, existing, & relocated VAV boxes to indicate the location of the VAV box above the ceiling.
   1. Letter Color: Black
   2. Background Color: Clear
   3. Maximum Label Size: To fit on ceiling grid
   4. Minimum Letter Size: 1/2 inch

2.2 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:
   1. Refrigerant Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.

2. Condensate Piping:

    a. Background Color: Yellow.
    b. Letter Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

   a. Constant-volume air systems.

2. Testing, Adjusting, and Balancing Equipment:

   a. Motors.
   b. Condensing units.
   c. Heat-transfer coils.

3. Procedures for Testing, Adjusting, and Balancing Existing Systems.
4. Controls Verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

   a. The Contract Documents examination report.
   b. The TAB plan.
   c. Needs for coordination and cooperation of trades and subcontractors.
   d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230700 "HVAC Insulation"

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record

observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.10 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.11 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Unit Ventilator Test Reports: For unit ventilators with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Heating-coil static-pressure differential in inches wg.
g. Outdoor airflow in cfm.
h. Return airflow in cfm.
i. Outdoor-air damper position.
j. Return-air damper position.
k. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. System-Coil Reports: For finned tube radiation and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water flow rate in gpm.
    e. Water pressure drop in feet of head or psig.
    f. Entering-air temperature in deg F.
    g. Leaving-air temperature in deg F.

H. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

I. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Entering-water temperature in deg F.
i. Leaving-water temperature in deg F.
j. Refrigerant expansion valve and refrigerant types.
k. Refrigerant suction pressure in psig.
l. Refrigerant suction temperature in deg F.

J. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.

h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.

k. Barometric pressure in psig.

M. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Engineer.

B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700
HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Mineral fiber.

2. Adhesives.
3. Mastics.
4. Lagging adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.

B. Related Sections:

1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
    d. Or approved equal.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.
    f. Or approved equal.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.
    g. Or approved equal.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.
    f. Or approved equal.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.
    f. Or approved equal.

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.
    f. Or approved equal.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.

c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
g. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.
f. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.
e. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.
g. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-52.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.
   f. Or approved equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
   f. Or approved equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKET

A. Self-Gripping Outdoor Jacket: Airex Manufacturing, Inc. E-Flex Guard, flexible UV and weather resistant insulation protector. The PVC plastic pipe insulation cover shall feature an integrated, outdoor rated durability, industrial grade full enclosure fastening system with Velcro fasteners. Wrapping tape or adhesive tape shall not be permitted.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or approved equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   e. Or approved equal.

2. Width: 3 inches.

3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
   d. Or approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015-inch thick, 3/4-inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 3/4-inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
      5) Or approved equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
      5) Or approved equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.
4) Or approved equal.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
3) Or approved equal.

b. Baseplate: Perforated, nylon sheet, 0.030-inch thick by 1-1/2 inches in diameter.
c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.
4) Or approved equal.

b. Baseplate: Galvanized carbon-steel sheet, 0.030-inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.

4) Nelson Stud Welding; Speed Clips.
5) Or approved equal.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.
3) Or approved equal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.
e. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult

coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and threelocations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.

5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return.
8. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Round and flat-oval, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Refrigerant Piping (ALL):

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Refrigerant Piping, Exposed:

1. Airex Manufacturing, Inc. E-Flex Guard insulation protective cover.

a. Color: White.

END OF SECTION

SECTION 232113
HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Condensate-drain piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.
B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
1. Condensate-Drain Piping: 150 deg F.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
1. Each type of Pipe and fittings (including but not limited to pressure-seal and grooved fittings) with service use clearly identified (Including pipe and fitting schedule for all services).
2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
3. Air control devices.
4. Chemical treatment.
5. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
C. Welding certificates.
D. Qualification Data: For Installer.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 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.

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. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
E. Grooved Installations: The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
F. All pressure-seal and grooved-joint couplings, fittings, valves and specialties shall be products of a single manufacturer. Grooving and pressure-seal tools shall be of same manufacturer as the grooved or pressure-seal component.
   1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

1.7 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion. Performing Preventative maintenance service for chemical water treatment for one year of Substantial Completion is part of this contract
B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Drawn-Temper Copper Tubing: ASTM B 88, Type M.
C. DWV Copper Tubing: ASTM B 306, Type DWV.
D. Wrought-Copper Fittings: ASME B16.22.
   1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   2. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
   3. Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.

E. Copper Pressure-Seal Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Viega Pro-press.

   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Minimum 200-psig working-pressure rating at 250 deg F.

F. Wrought-Copper Unions: ASME B16.22.

2.2 PLASTIC PIPE AND FITTINGS

A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
F. Solvent Cements for Joining Plastic Piping:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
      a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

      c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Pipeline Seal and Insulator, Inc.

   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.

      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

C. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company of America.

   2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints for all indoor and thru the wall or thru the roof outdoor piping. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints for outdoor piping for air handling units.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
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 to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
Q. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
F. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements.
    2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
    3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
    4. PVC Nonpressure Piping: Join according to ASTM D 2855.

G. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

END OF SECTION

SECTION 232300
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-32:
   1. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
   2. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.3 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, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, 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 oil traps, double risers, 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. Field quality-control test reports.
D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type ACR

B. Wrought-Copper Fittings: ASME B16.22.
C. Wrought-Copper Unions: ASME B16.22.
D. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

A. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

B. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F
6. Superheat: Nonadjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.
5. Or approved equal.

B. ASHRAE 34, R-32: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
B. Hot-Gas and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
D. Safety-Relief-Valve Discharge Piping:
1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.
B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
D. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

E. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
F. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
G. Install filter dryers in liquid line between compressor and thermostatic expansion valve**,** and in the suction line at the compressor.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
B. Install refrigerant piping according to ASHRAE 15.
C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
D. 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.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping adjacent to machines to allow service and maintenance.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Select system components with pressure rating equal to or greater than system operating pressure.
J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
M. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

N. When brazing or soldering, 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.
O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
P. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
S. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 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 refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Open shutoff valves in condenser water circuit.
   2. Verify that compressor oil level is correct.
   3. Open compressor suction and discharge valves.
   4. Open refrigerant valves except bypass valves that are used for other purposes.
   5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 233113
METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

B. Welding certificates.
C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
   3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90 (Z275).
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.

   2. Maximum Thermal Conductivity:
      a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

   3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

      b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick [galvanized steel] [aluminum] [stainless steel]; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

   6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).

   7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches.
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

   10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
   8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.

   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
F. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.

   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
G. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction

loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class A.
4. Outdoor, Return-Air Ducts: Seal Class A.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class A.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class A.
8. Unconditioned Space, Return-Air Ducts: Seal Class A.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class A.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class A.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 2-Inch wg (750 Pa): Test representative duct sections ,totaling no less than 25 percent of total installed duct area for each designated pressure class.

   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.7 DUCT CLEANING

A. Clean new ducts before testing, adjusting, and balancing.
B. Use service openings for entry and inspection.
    1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
    2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
    3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
    1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
    2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
    1. Air outlets and inlets (registers, grilles, and diffusers).
    2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
    3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
    4. Coils and related components.
    5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
    6. Supply-air ducts, dampers, actuators, and turning vanes.
    7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
    1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
    2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
    3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
    4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
    5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
    6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except for systems otherwise noted below.
B. Supply and Outdoor Air Ducts:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return and Exhaust Ducts:
   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel.

E. Liner:
   1. Supply Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.
   2. Outdoor Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.

F. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm (5 m/s) or Lower:
         a. Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         b. Mitered Type RE 4 without vanes.

      b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
         a. Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         b. Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

      c. Velocity 1500 fpm (7.6 m/s) or Higher:
         a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
         c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      a. Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      c. Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      d. Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, Stamped or pleated.

G. Branch Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
      a. Rectangular Main to Rectangular Branch: 45-degree entry.
      b. Rectangular Main to Round Branch: Spin in.

   2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
      a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
      b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
      c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION

SECTION 233116
PRE-MANUFACTURED EXTERIOR DUCTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Phenolic-foam ducts and fittings.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
2. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.
3. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.
4. Division 05 Section “Cold Form Steel Framing” specification for coordination of mounting vertical exterior mounted ductwork.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with SMACNA's "Fibrous Glass Duct Construction Standards" and performance requirements and design criteria indicated.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "Phenolic Duct Construction Standards."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Phenolic-foam duct materials.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers:

1. Dual-Tech system, by PTM Manufacturing, LLC. Newark, DE, 19713 302-455-9733.
2. Thermaduct LLC.
3. Tuff Duct by Hranec Corporation
4. Or approved equal.

B. Duct Panel: CFC/HCFC-free phenolic-foam autohesively bonded on both sides to a 1 mil low vapor permeability aluminum foil facing reinforced with a 0.2" glass scrim.

1. Duct work shall be double wall R-16.
2. Insulation panels shall comprise a 3.4-3.75 nominal density.
3. Maximum Temperature: 158 deg F inside ducts or ambient temperature surrounding ducts.
4. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
5. Minimum compressive strength: 29 psi.
6. Permeability: 0.0002 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
9. Foil tape used for sealing the insulation edges shall be a minimum thickness of 1.25 mils.
10. Required Markings: UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for closure materials.
11. The rigid phenolic insulation panels used in the fabrication of the exterior ductwork and/or ductwork sections fabricated from the manufacturers system shall achieve the following fire and smoke performance requirements:

    a. ASTM E 84-08a – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 flame spread and 50 smoke developed indices.
    b. UL 723 – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 flame spread and 50 smoke developed indices.
    c. UL 181 – UL/ULC classification as a Class 1 air duct to NFPA Standards 90A & 90B.

C. Closure Materials:

1. V-Groove Adhesive: Silicone.

    a. As approved by or supplied by manufacturer of exterior ducting.

    b. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

    c. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.

    a. As approved by or supplied by manufacturer of exterior ducting
    b. Tape: Aluminum foil tape imprinted with listing information.
    c. Minimum Tape Width: 3 inches.
    d. Water resistant.
    e. Mold and mildew resistant.

D. Fabrication:

1. Sizing: Panel system shall be sized in four overlapping sections to provide a complete seal surrounding ducting.
2. Shall be laminated to the weather barrier and sized to allow for sufficient overlap. Second wall ducting shall be adhered utilizing appropriate contact method.
3. Where feasible all general fabrication shall be performed in the shop and be based off of approved project drawing or direct field measurements.
4. Field fabrication should be limited to routing and sealing of the ducting sections to allow for duct angle, supports, gauges or other duct related necessities. All routed areas shall be resealed with appropriate foil faced cast tape. No insulation/phenolic material shall be exposed to the environment.
5. Fabricate 90-degree mitered elbows to include turning vanes.

2.2 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Penetration into duct is not permitted.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from dcuts.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts with fewest possible joints.

C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

F. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches.

G. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

H. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

I. Install foam ducts and fittings to comply with manufacturer’s guidelines.

J. Ducting system sections shall be fitted into place and connected using aluminium flange and gasket as designed by manufacturer.

K. Weather barrier shall be fabricated of mill finished embossed aluminum sheeting, 0.032” in thickness. Exposed seams to be covered with 1” butyl and a 8” embossed aluminum beaded bands, secured with #10 self-tapping, stainless screws with weather seal washers.

L. At weather barrier abutment locations, and industrial grade RTV silicone caulk shall be utilized, where applicable.

M. Seams exposed to the weather shall be covered and sealed with a 1” wide by 1/8” thick butyl compound.

N. All screws utilized to fasten panel system together shall be #10 x ½” self-tapping, stainless steel, weather seal washer screws.

O. Contact cement or 2-sided adhesive tape shall be utilized for laminating insulation material to the weather barrier sheeting.

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for phenolic-foam ducts and fittings to comply with manufacturer’s guidelines.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "Phenolic Duct Construction Standards" for branch, outlet and inlet, and terminal unit connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of nonmetal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch duct as recommended by duct manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
2. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of ducts or duct accessories.
3. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.6 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Outdoor Ducts and Fittings:

1. Phenolic-Foam Rectangular Ducts and Fittings:

a. Minimum Panel Thickness: 1-3/32 inches.

b. Aluminum Cladding: Minimum 0.032 inch thick.
c. Polymeric Sealing System: Coat ducts, including gang-nail couplings, grip flanges, and couplings.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Control dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

1.3 SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
      a. Special fittings.
      b. Manual volume damper installations.
      c. Duct security bars.

      d. Wiring Diagrams: For power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
C. Source quality-control reports.
D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fusible Links: Furnish quantity equal to [10] percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.
D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Potorff.
   3. Ruskin Company.

B. Description: Gravity balanced.
C. Maximum Air Velocity: 2000 fpm.
D. Maximum System Pressure: 1-inch wg.
E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.
F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
G. Blade Action: Parallel.
H. Blade Seals: Neoprene, mechanically locked.
I. Blade Axles:
   1. Material: Nonferrous metal.
   2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.
K. Return Spring: Adjustable tension.
L. Bearings: Steel ball or synthetic pivot bushings.
M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.

4. Chain pulls.

5. Screen Mounting: Front mounted in sleeve.
   a. Sleeve Thickness: 20-gage minimum.
   b. Sleeve Length: 6 inches minimum.

6. Screen Material: Galvanized steel.
7. Screen Type: Insect.
8. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Greenheck.
      b. Potorff.
      c. Ruskin Company.

   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.

   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.

   6. Blade Axles: Nonferrous metal.
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

   8. Tie Bars and Brackets: Galvanized steel.

B. Low-Leakage, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Greenheck.
      b. Pottorff; a division of PCI Industries, Inc.
      c. Ruskin Company.

   2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat shaped.
      b. Galvanized-steel channels, 0.064 inch thick.
      c. Mitered and welded corners.

d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Nonferrous metal.
7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.4 CONTROL DAMPERS

A. Control Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Greenheck.
      b. Potorff.
      c. Ruskin Company.

B. General Requirements:

   1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
   2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

   1. AMCA Certification: Test and rate in accordance with AMCA 511.
   2. Leakage:

      a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
      b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
      c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
      d. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.

   3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
   4. Velocity: Up to 3000 fpm

5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:

    a. Hat, U, or angle shaped.
    b. 0.08-inch-thick extruded aluminum 16-gauge-thick, galvanized sheet steel 18-gauge-thick stainless steel.
    c. Mitered and weldedcorners.
    d. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

    a. Multiple blade with maximum blade width of 8 inches.

    b. Opposed-blade design.
    c. Aluminum.
    d. 16-gauge-thick single skin

5. Blade Edging Seals:

    a. Replaceable Closed-cell neoprene.
    b. Inflatable seal blade edging, or replaceable rubber seals.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; stainless steel.
8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:

    a. Oil-impregnated stainless steel sleeve.
    b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Two position.

    a. Sufficient motor torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    b. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:

    a. Temperature: Minus 40 to plus 130 deg F.
    b. Humidity: 5 to 95 percent relative humidity noncondensing.

6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
C. Material: Galvanized steel.
D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
E. Vane Construction: Double wall.
F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Greenheck Fan Corporation.
   3. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.

B. Labeled according to UL 1978 by an NRTL.
C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.
   4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.
C. Coatings and Adhesives: Comply with UL 181, Class 1.
D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.
E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd..
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd..
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.
F. Install test holes at fan inlets and outlets and elsewhere as indicated.
G. Install fire and smoke dampers according to UL listing.
H. Connect ducts to duct silencers [with flexible duct connectors] [rigidly].
I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Upstream and downstream from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   7. At each change in direction and at maximum 50-foot spacing.
   8. Upstream and downstream from turning vanes.
   9. Upstream or downstream from duct silencers.
   10. Control devices requiring inspection.
   11. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.
K. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
M. Install flexible connectors to connect ducts to equipment.
N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
O. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
Q. Install duct test holes where required for testing and balancing purposes.
R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 233423
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. In-line above ceiling mounted ventilators.
   2. Centrifugal ventilators - roof downblast

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit.

1.8 WARRANTY

A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of two years from substantial completion. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.

4. Or approved equal.

B. Housing: Downblast; removable spun-aluminum dome top and outlet baffle; square, one-piece aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Spark-resistant, all-aluminum wheel construction.

E. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.

2. Overall Height: 18 inches (450 mm).

3. Sound Curb: Curb with sound-absorbing insulation.
4. Hinged sub-base to provide access to damper or as cleanout for grease applications.
5. Metal Liner: Galvanized steel.

2.2 MOTORS

A. Comply with requirements in Division 23 Section "Motors."

B. Enclosure Type: Totally enclosed, fan cooled.

C. ECM Type: Comply with requirements in Division 23 Section "Motors."

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 233713
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Rectangular and square ceiling diffusers
2. Adjustable bar registers
3. Fixed face registers
4. Spiral duct grille

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square Ceiling Diffusers (Tag-A):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Three cone.
7. Mounting: Surface.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade, operable from diffuser face.
10. Accessories:

    a. Sectorizing baffles.

B. Square Ceiling Diffusers (Tag-B):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 12 by 12 inches.
6. Face Style: Three cone.
7. Mounting: Surface.
8. Pattern: Fixed.
9. Dampers: Radial opposed blade, operable from diffuser face.
10. Accessories:

    a. Sectorizing baffles.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grille Tag-C:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Titus.

    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
5. Core Construction: Integral.

6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.

8. Mounting: Countersunk screw.
9. Accessories:

    a. Rear-blade gang operator.

B. Fixed Face Bar Grille, Tag-D:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Price.
    b. Titus.
    c. Krueger.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.

6. Frame: 1-1/4 inches wide.

7. Mounting: Countersunk screw.
8. Accessories:

    a. Opposed blade damper for all concealed gypsum board installations.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 233723
HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof hoods.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient;, material surfaces.

D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. PennBarry.
4. Or approved equal.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Aluminum sheet, minimum 0.063-inch thick base and 0.050-inch thick hood; suitably reinforced.

D. Base: Hinged base for damper access.

E. Roof Curbs: Provide adapter curb. Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Built-in cant and mounting flange.

2. Overall Height: 12 inches.
3. With damper tray and damper access door.

F. Bird Screening: Aluminum, 1/2-inch square mesh, 0.063-inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts". Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 235523
LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes low-intensity, gas-fired, infrared unitary radiant heaters.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of high-intensity, gas-fired, radiant heaters, as well as procedures and diagrams.

4. Include diagrams for power wiring.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gas-fired, radiant heaters to include in emergency, operation, and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of radiant heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period: All warranty periods listed below are from date of Substantial Completion.

1. Burner Assembly: Three years.
2. Combustion and Emitter Tubes: Three years.
3. Heater Controls: Two year.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. CSA certified, with CSA Seal and certification number clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.

B. UL listed and labeled, with UL label clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 UNITARY HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Combustion Research Corporation.
2. Detroit Radiant Products Company.
3. Roberts-Gordon, LLC.
4. Or approved equal

B. Description: Factory-assembled, indoor, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.

C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.

D. Burner Assembly:

1. Combustion-Air Inlet: Ducted horizontal to outdoors through sidewall with vent caps.

2. Burner Control Housing: Steel.

    1. Totally enclosed with steel access cover.
    2. Sight glass for visual inspection of burner.

    3. Finish: Enameled finish or powder-coated finish.

3. Burner: Stainless steel.
4. Ignition System: Modulating Gas Valve and Hot Surface Electronic Ignition.

E. Heat Exchanger Tube: 4-inch- diameter, 16-gage, aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.

F. Reflector: 0.024 inch thick Polished aluminum, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors or

entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-degree tilt from vertical.

G. Accessories:

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees from vertical.
2. Protective grilles mounted to reflectors to protect emitter tubing.
3. Stainless-steel flexible connector with manual valve for gas supply.
4. Hanger chain with "S" hooks.
5. 3/16-inch- diameter, aluminized-steel wire tubing hangers and reflector supports.
6. Rigid mounting kits.
7. Outdoor use conversion kit.
8. Clearance warning plaque.

2.3 CONTROLS AND SAFETIES

A. Gas Control Valve: Modulating, regulated redundant 24-V ac gas valve that contains pilot solenoid valve, electric gas valve, 100% Shut-Off, Prepurge, Post-purge, Auto Reset, Tri-Color LED Status/ Fault Indicator

B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structures, substrates, areas and conditions, with Installer present, for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance of the Work.

B. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections before equipment installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and systems according to NFPA 54.

B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.

1. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Maintain manufacturers' recommended clearances for combustibles.

3.3 CONNECTIONS

A. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping Connect gas piping to gas train inlet. Provide stainless steel flexible gas hose connection. Provide union with enough clearance for burner removal and service.

1. Gas Connections: Connect gas piping to radiant heaters according to NFPA 54.

B. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and maintenance.

C. Electrical Connections: Comply with applicable requirements in Section 260519 "Conductors and Cables."

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

    1. Test procedures used.
    2. Test results that comply with requirements.
    3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Gas-fired, radiant heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial-temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, radiant heaters.

END OF SECTION

SECTION 237413
PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units).

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Delegated-Design Submittal: For RTU supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind-Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces of 115 MPH for Basic Wind Speed, Building Classification Category III and minimum 50 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of unit projected on a vertical plane that is normal to the wind direction and 45 degrees either side of normal for wind-restraint performance requirements.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

D. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Two set of filters for each unit. (One set for installation at completion of project and one set for Owner’s attic stock)

1.8 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.
3. Packaged air-cooled condenser units shall be certified in accordance with ANSI/ AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
4. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. 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.

F. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

G. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.

H. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard parts and associated labor, but not less than five years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard parts and associated labor, but not less than 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON.
2. Carrier.
3. Daiken.
4. Or approved equal.

B. Note that Engineer will review in detail submittals for this equipment and will not approve incomplete submittals that do not clearly indicate or include in detail the items indicated to be provided in the above submittal section of this specification. Engineer will not approve submittals that do not meet or exceed all performance and construction requirements indicated in the specifications and drawings for this project. Any of the three manufacturers products noted above are to be provided by authorized manufacturer's representative companies of the Contractor whom is submitting a proposal. Engineer will not approve submittals that do not come from the authorized manufacturer's representative company for the Contractor whom is submitting a proposal. If authorized manufacturer's representative company for the Contractor is different than authorized manufacturer's representative company of the Engineer then authorized manufacturer's representative company for the Contractor shall contact and coordinate with authorized manufacturer's representative company of the Engineer. If contact and coordination are not performed Engineer will not approve submittals.

2.3 PACKAGED UNITS

A. General Description

1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, electric heaters, exhaust fans, energy recovery wheels, and unit controls.
2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
5. Estimated sound power levels (dB) shall be shown on the unit schedule.
6. Installation, Operation and Maintenance manual shall be supplied within the unit.
7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.

3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

6. Access to filters, dampers, cooling coils, reheat coil, heaters, exhaust fans, energy recovery wheels, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.

7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.

9. Unit shall be provided with base discharge and return air openings or horizontal discharge and return air opening (As indicated on contract drawings). All openings through the unit shall have upturned flanges of at least 1/2 inch in height around the opening. All openings shall be in locations and orientation are shown on contract drawings. Manufactures that have different locations and orientation are responsible for all extra costs incurred as a result which will modify basis of design including but not limited to extra costs by contractor and Engineer for time to review the changes.

10. Unit shall include lifting lugs on the top of the unit.

11. Unit base pan shall be provided with 1/2-inch thick foam insulation.

12. Cabinet Surface Condensation:

    a. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
    b. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

C. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.

2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

3. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI convenience outlet disconnect switch in the unit control panel wired prior to unit mounted disconnect switch.

4. Unit shall be provided with minimum 10kA SCCR rating, or as indicated on contract documents.

D. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be inverter rated where noted on contract drawings.

5. Motors shall be high efficiency electrically communicated motor where noted on contract drawings.

E. Cooling Coils

1. Evaporator Coils

    a. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.

    b. Coils shall be 6 row high capacity

    c. Coils shall have interlaced circuitry and shall be 6 row high capacity.

    d. Coils shall be helium leak tested.

e. Coils shall be furnished with factory installed thermostatic expansion valves.

F. Refrigeration System

1. Unit shall be factory charged with R-454B refrigerant.

2. Compressors shall be scroll type with thermal overload protection and independently circuited.

3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.

4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.

5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.

6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.

7. Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where noted on contract drawings.

8. Unit shall be two-step scroll type compressor with thermal overload protection and be independently circuited. Two-step compressors shall include 2 stages of capacity control, 65% and 100% where noted on contract drawings.

9. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where there is more than one compressor indicated where noted on contract drawings.

10. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

11. Where there are more than one refrigerant circuits, Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space where there is more than one compressor indicated.

12. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

13. Each refrigeration circuit shall include adjustable compressor lockouts.

H. Condensers

1. Air-Cooled Condenser

   a. Condenser fans shall be a vertical discharge, axial flow, variable speed direct drive fans.

   b. Coils shall be designed for use with R-454B refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes or constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design of copper tubes shall be sine wave rippled.

   c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

   d. Coils shall be helium leak tested.

   e. Condenser fans shall be high efficiency electrically commutated motor driven variable speed with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35 degree F with adjustable compressor lockout.

I. Gas Heating

1. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

2. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

3. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

4. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.

K. Filters

1. Unit shall include 2-inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8 and 4-inch thick, pleated panel filters with an ASHRAE efficiency of 85% and MERV rating of 13, upstream of the cooling coil.

2. Unit shall include 1-inch aluminum mesh pre filters upstream of the outside air opening.

3. Units shall include a Magnehelic gauge mounted in the controls compartment.

L. Outside Air/Economizer

1. Units shall include 0-100% economizer consisting of a motor operated outside air damper and return

air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return, DDC actuator. Unit shall include outside air opening bird screen and outside air hood with rain lip and barometric relief dampers.

N. Curbs

1. Materials: Galvanized steel with corrosion-protection coating, watertight and continuously gasketed, and factory-installed wood nailer; complying with NRCA standards.
2. Curbs shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit. Sides of curbs to be lined with 1inch neoprene coated fiberglass insulation and include a wood nailer. Install RTUs on curbs and coordinate roof penetrations and flashing with existing roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
3. Factory Applied Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

    a. Materials: ASTM C 1071, Type I or II.
    b. Thickness: 1 inch.

4. Samsel Upper ES: Provide RTU-2 and 4 with custom plenum adapter curb with horizontal supply and return air duct connections to connect to existing roof mounted ductwork.
5. Middle School: Curbs to be adapter type and designed to match existing supply and return openings.
6. High school, RTU-15, 16, ERU-1 and ERU-2: Curbs to be adapter type and designed to match existing supply and return openings.

2.5 CONTROLS

A. Factory Installed and Factory Provided Controller:

1. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
2. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
3. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
4. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

B. Additional field provided and installed Control devices are specified in Section 230900 "Instrumentation and Control for HVAC."

C. Unit shall be provided with BACnet communications interface. Refer to Sequence of Operations indicated on contract documents.

D. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Connect supply and return ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.

20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

27. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.

29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 238126
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Operation and maintenance data.

1.3 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. LG.
2. Toshiba Carrier.
3. Samsung.
4. Or approved equal.

2.2 INDOOR UNITS

A. Concealed Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
4. Fan Motors:
a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Filters: Permanent, cleanable.
7. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
2) Depth: A minimum of 2 inches deep.

b. Single-wall, galvanized-steel sheet.
c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
1) Minimum Connection Size: NPS 1.

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
1. Compressor Type: Scroll.

2. Inverter compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant Charge: R-32.

C. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
D. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
E. Fan: Aluminum-propeller type, directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.
G. Low Ambient Kit: Permits operation down to 0 deg F.
H. Mounting Base: Roof curb rails.
I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 ACCESSORIES

A. Thermostat: Hard Wired Infrared functioning to control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection, including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
B. Install roof-mounted, Anchor units to equipment supports with removable, cadmium-plated fasteners.

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
B. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
C. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 238239
UNIT HEATERS

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Plans, elevations, sections, and details.
   2. Location and size of each field connection.
   3. Details of anchorages and attachments to structure and to supported equipment.
   4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

   5. Location and arrangement of piping valves and specialties.

   6. Location and arrangement of integral controls.
   7. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish two spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Marley Electric Heating; a division of Marley Engineered Products.
4. QMark Electric Heating; a division of Marley Engineered Products.
5. Or approved equal.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners, and tamperproof thermostat.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

G. Controls: Unit-mounted thermostat.

H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 00 00
ELECTRICAL SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Divisions 1 and 26 apply to this section.

1.2 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 1-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.3 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

D. EC: Electrical Contractor.

E. MC: Mechanical Contractor.

F. PC: Plumbing Contractor.

G. GC: General Contractor.

H. Owner: Stafford Volunteer Fire Company.

1.4 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the electrical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

1. Demolish electrical conduit, wiring and equipment as shown on the drawings, as required in these specifications and as required to accommodate the new and renovation construction activities. Remove wiring back to the respective source for all associated equipment indicated to be demolished and maintain the electrical circuit integrity as required for equipment to remain. Remove exposed conduit back to the respective source for all associated equipment indicated to

be demolished – cut, cap and label conduits that are embedded in permanent walls and floors; provide cutting and patching of the same.

2. For detailed scope of work for each system, refer to the respective Division specification sections.
3. Construction Sequencing requirements:
   a. Any and all power outages shall be coordinated with the Owner a minimum of 7 days in advance.
   b. Working hours and days: Refer to the Division 0 and 1 specifications all requirements.
4. Relocate existing panelboards to Electrical Room. Provide and install new feeders and conduits.
5. Provide and install retrofit breakers in existing panelboards.
6. Provide and install new LED lighting fixtures, including switches and occupancy sensor controls.
7. Provide and install new emergency lighting fixtures.
8. Provide and install new receptacles.
9. Provide and install wiring and conduit for new branch circuit wiring.
10. Install new conduits, feeder wiring, and branch circuit wiring as indicated on plans.
11. Install new panelboard, conduit, feeder wiring, and branch circuit wiring as indicated on plans.
12. Provide and install wiring and conduit for lighting, receptacles, and HVAC equipment.
13. Provide and install fused or non-fused disconnect switches, or circuit breakers at the various pieces of equipment as required by the N.E.C. Code.
14. Provide and install new addressable fire alarm system, including initiation devices, booster panels, and other peripheral devices and equipment. Provide programming and testing of the entire system per NFPA 72, and training.
15. Provide and install addressable monitoring modules for the tamper switches, flow switches and fire pump controller provided by the fire protection sub-contractor.
16. Provide and install data equipment rack, grounding, and other appurtenances in second floor office.
17. Provide and install new data, telephone, coax cables, including jacks, faceplates, patch panels and all terminations at the jack and data rack.
18. Install new back boxes and raceway for all low-voltage and communication systems as documented on the plans and specifications.
19. Install new overhead door motor and controls, provided by GC.
20. Reconnect existing overhead door motors and controls.
21. Adjust connections to electrical motors to insure proper rotation.
22. All electrical work on this project shall comply with the 2020 NEC including all local New Jersey revisions, additions, errata and the like.
23. All necessary rigging.
24. Removal of trash and general clean-up.
25. All necessary permits, approvals, fees, etc.
26. Owner training.
27. Operations and maintenance manuals.
28. As-built drawings.
29. Cutting, patching and clean-up.
30. Completion Date: All electrical work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

B. It will be the responsibility of the Contractor to examine all Drawings to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

C. Coordination Between Mechanical (MC), Electrical (EC) and Plumbing (PC) Contractors:

1. The Electrical Contractor shall:

   a. Receive and set the motor starters as provide by the Mechanical and Plumbing Contractors.
   b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
   c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
   d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
   e. Adjust connections to electrical motors to insure proper rotation.
   f. Provide duct detectors and tubes to the MC for installation in the ductwork. EC shall wire and program the duct detectors and remote test stations into the fire alarm system. MC shall wire from the detectors into the HVAC equipment for shut-down.
   g. Provide 120V to junction boxes for the MC to install 120-24V transformers. EC to receive the transformer from the MC and install & wire up the 120V side of the transformer. MC shall provide all 24V wiring.

2. The Mechanical Contractor will:

   a. Furnish and set all motors for mechanical equipment.
   b. Furnish all motor starters, starter/disconnects, HVAC unit mounted disconnects, contactors, pushbuttons and switches for local and remote control of all HVAC equipment and turn over to the Electrical Contractor for installation.
   c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
   d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
   e. Furnish wiring diagrams for the systems, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
   f. Provide all control wiring including 120V controls, 120V power and 120/24V control power transformers as required for a complete and fully functional HVAC DDC control system.
   g. Provide 120V-24V transformers to the EC for mounting and wiring.
   h. Receive duct detectors from the EC and install in the ductwork. MC shall provide and install all shut-down and system activation wiring from the smoke detectors to the respective HVAC units.

3. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.

D. Architectural Equipment Wiring and Connections:

1. All equipment for will be furnished and set by the Equipment Contractor.
2. The Electrical Contractor shall run all electrical conduit and wiring to each piece of equipment requiring electrical service and shall make all final connections to the equipment.
3. The equipment and required wiring connections are shown on the drawings.
4. This Electrical Contractor shall furnish disconnect switches at the various pieces of equipment as required by the NEC.

1.5 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the Owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Project shall include a 1-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division specification sections.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or Approved Equal

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Allowable conduit and MC cable locations:

1. Conduit shall be used for all feeders to all panelboards.
2. Surface mounted metallic raceway shall be used for all public, exposed conditions where fishing new MC cable is not possible in existing poured concrete walls.
3. MC Cable may be used for all branch circuits above drop ceilings and in drywall partitions.
4. Interior branch circuits in exposed ceiling conditions and in masonry block walls shall be in raceway.
5. Exterior wiring shall be in RGS conduit above grade and PVC conduit below grade.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.
5. Or Approved Equal

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation (Indoors): Comply with NEMA WC 70 for Types THHN-THWN. Conductor sizes #12 and #10 shall be solid and #8 and larger shall be stranded.

D. Conductor Insulation (Outdoors and Underground): Comply with NEMA WC 70 for Type XHHW. Conductor sizes #12 and #10 shall be solid and #8 and larger shall be stranded.

E. Type MC Cable: Galvanized armor with copper conductors. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

F. Aluminum cable will not be acceptable.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. Or Approved Equal

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.
5. Or Approved Equal

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders Indoors: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders Outdoors: Type XHHW, single conductors in RGS raceway.

C. Underground Feeders: Type XHHW, single conductors in Type PVC schedule 40 UL listed conduit, encased in 3" of concrete.

D. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-THWN, single conductors in raceway.

E. Use the following wiring methods as indicated for all branch circuits:
   1. Outdoor, underground: Type PVC schedule 40 UL listed conduit.
   2. Indoor, Type THHN-THWN, single conductors in raceway:
      a. Mechanical rooms.
      b. Electrical rooms.
      c. Sprinkler rooms.
      d. Elevator machine rooms.
      e. Above hard / drywall ceilings.
      f. In exposed ceiling areas.

   3. Indoor, concealed in drywall walls or accessible ceilings and not in areas listed above in D.2.: Type MC galvanized steel multi-conductor cabling with ground.

F. Dimming Lighting Branch Circuits: Where branch circuit wiring is routed to 0-10V dimming light fixtures and switches, UL listed metalclad type MC-PCS (Luminary) cable.

G. Class 1 Control Circuits: Plenum type cable.

H. Class 2 Control Circuits: Type galvanized MC Cable.

I. Fire Alarm: Type MC FPLP cabling where concealed in drywall walls, accessible ceilings and partitions and Type THHN-THWN, in raceway where exposed or as outlined in D.2 above.
   1. NAC circuits: #14-4 MC FPLP
   2. SLC circuits: #16-4 MC FPLP

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Common neutrals shall not be used. Provide individual, dedicated neutral for each circuit.

H. Common grounds are acceptable, in accordance with the NEC.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.

    a. Megger testing for 600V feeder conductors.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning cabling and retest as specified above.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Building grounding.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems and telecommunication systems based on NETA MTS.

   a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
   b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.

2. Bonding Conductor: Minimum No. 4 AWG, stranded conductor or as noted on the drawings.
3. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Exposed Cables and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Compression Connectors for all Concealed and Underground Cables: Compression kits of types recommended by kit manufacturer for materials being joined and installation conditions. Must comply with IEEE std 837-2002, UL 467 Listed and CSA 22.2 Certified or approved equal by the Engineer.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m in diameter).

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Compression connectors.
3. Connections to Ground Rods at Test Wells: Compression connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 12 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

4. Panel testing: Perform ground resistance testing between all existing and new panel boards and the main switchboard in the main electrical rooms. Provide test report indicating the resistance for each panel to the main.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity 500 kVA and More: 5 ohms.
3. Structural Steel / Lightning Protection Grounds: 25 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit (galvanized).

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.; a division of Cooper Industries.
    c. ERICO International Corporation.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut; Tyco International, Ltd.
    g. Wesanco, Inc.
    h. Or Approved Equal

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Galvanized Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
        5) Or approved equal.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.
        6) Or approved equal.

3. Concrete Inserts: Stainless Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway (including trapeze type systems): Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter. Exception:
   1. Where attached to wood framing systems in the building, the support spacing shall be double the requirements scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70.
   2. The intent of this exception is to distribute the loading of the raceways on the wood framing system.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with galvanized steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.

   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, floor boxes, surface divided non-metallic raceway and cabinets for electrical wiring.

B. Refer to Section “Low-Voltage Electrical Power Conductors and Cables” for allowable applications of conduit vs. MC Cable.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RMC or GRS: Galvanized rigid metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Maverick Tube Corporation.
5. O-Z Gedney; a unit of General Signal.
6. Wheatland Tube Company.
7. Or Approved Equal

B. Rigid Steel Conduit: ANSI C80.1 with threaded fittings.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3, with compression fittings.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Die-cast, compression type.
2. Fittings for RGS: Threaded type.

G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. CANTEX Inc.
3. CertainTeed Corp.; Pipe & Plastics Group.
4. Condux International, Inc.
5. ElecSYS, Inc.
6. Electri-Flex Co.
7. Lamson & Sessions; Carlon Electrical Products.
8. Manhattan/CDT/Cole-Flex.
9. RACO; a Hubbell Company.
10. Thomas & Betts Corporation.
11. Or Approved Equal

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type PVC Schedule 40, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Spring City Electrical Manufacturing Company.
9. Thomas & Betts Corporation.
10. Or Approved Equal

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.

2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."

6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 12 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
8. Listings: UL listed.
9. Ratings: ANSI Tier 22.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.
e. Quazite.
f. Or Approved Equal

2.5 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased ductbank as indicated on the drawings.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
6. Application of Handholes and Boxes for Underground Wiring:
   a. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 22 structural load rating.
   b. Route conductors and cables around (service loop) the handhole prior to exiting.

B. Comply with the following indoor applications, unless otherwise indicated; refer also to Section “Low-Voltage Electrical Power Conductors and Cables”:
1. For allowable indoor raceways and MC Cable, refer to Section 260519.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
3. Damp or Wet Locations or in Kitchens: Rigid steel conduit.
4. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. Electrical Metallic Tubing: Use die-cast compression fittings.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

L. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving", except provide a minimum of 3" of silt stone surrounding conduit prior to backfill, except where indicated to be concrete encased.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Tape: Bury detectable warning tape approximately 12 inches (300 mm) above direct-buried conduits.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.
8. Self-adhesive labels for all switches and receptacles.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Emergency Circuits: Black letters on a red field.
3. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core (detectable).
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Multiple Services: Label multiple services in the same building indicating the location of the other service and the purpose of the service.

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.6 kg), minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color-coding bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and aluminum wraparound marker labels. Identify source and circuit number of each set of conductors. For all conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. For all conditions (more than one conductor in a box), identify each ungrounded conductor according to source and circuit number.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled; label with the panel source and circuit number for all equipment, in addition to labeling the equipment for identification and OSHA requirements:

   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Junction boxes.
   d. Electrical switchgear and switchboards.
   e. Transformers.
   f. Electrical substations.
   g. Emergency system boxes and enclosures.
   h. Motor-control centers.
   i. Disconnect switches.
   j. Enclosed circuit breakers.
   k. Motor starters and drives.
   l. Push-button stations.
   m. Power transfer equipment.
   n. Contactors.
   o. Remote-controlled switches, dimmer modules, and control devices.
   p. Battery inverter units.
   q. Battery racks.
   r. Power-generating units.
   s. Voice and data cable terminal equipment.
   t. Master clock and program equipment.
   u. Intercommunication and call system master and staff stations.
   v. Television/audio components, racks, and controls.
   w. Fire-alarm control panel and annunciators.
   x. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   y. CCTV systems.
   z. Monitoring and control equipment.
   aa. Uninterruptible power supply equipment.
   bb. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
   cc. Mechanical, plumbing and architectural equipment.

dd. Disconnects, receptacles and switches, including panel source and circuit number. Minimum 10 pt font. See 3.2.K below for additional requirements.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

K. For all receptacles and switches, provide the following labeling: Provide clear, self adhesive label on all faceplates with minimum 10 pt black lettering identifying the panel source and circuit number.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 – **GENERAL**

A. Section Includes:

1. Digital Lighting Controls
2. Emergency Lighting Control

B. Related Sections:

1. Section 265119 –LED Interior Lighting.
2. Drawings and general provision of the Contract, including General Conditions and Division 01 Specification Sections apply to this Section
3. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings

1.2 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:

1. Digital Room Controllers – Self-configuring, one or two relay plenum-rated controllers for on/off control. Selected models include 0-10 volt dimming outputs.
2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene.
3. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
4. Emergency Lighting Control Unit– Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

1.3 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local energy codes are more stringent, provide a minimum application of lighting controls as follows:

1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors

are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

2. Daylit Areas – Provide daylight-responsive automatic control where indicated on plans.

1.4 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.

2. Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)

3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:

1. Indicates where sensor is proposed to be installed.

2. Prove that the sensor is suitable for the proposed application.

1.5 QUALITY ASSURANCE

1.6 Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.7 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 40° C (32° to 104° F).

2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

A. Provide a five year limited manufacturer’s warranty on all room control devices and panels.

1.9 MAINTENANCE

A. Spare Parts:

1. (1) Room Controller

2. (1) Occupancy Sensor.

3. (1) 4-Button Digital Switch

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer (Basis of Design) or approved equal:

1. Hubbell Building Systems
    a. System: NX Series
2. Basis of design product: Hubbell NX Series or subject to compliance and prior approval with specified requirements of this section, one of the following or approved equal:
    a. Cooper Lighting Controls
    b. Acuity Brands Lighting Controls
    c. Wattstopper Digital Lighting Management (DLM)
    d. Or approved equal

2.2 DIGITAL ROOM CONTROLLER

A. As indicated and where shown on the plans, install Hubbell Building Automation NXRC series Room Controller(s), or approved equal, to control the quantity of lighting and plug loads required.

B. Where indicated, the room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads.

C. The room controller shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.

D. Room controllers and associated room control components shall operate in a totally stand alone mode and not require the use of a network, software, computer or server for local control functions.

E. Provide room controller with timeclock feature, in corridors and in reflection area.

F. Mechanical:

1. The room controller housing shall measure 5.75" X 3.85" X 1.3" and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.

2. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.

3. Four RJ45 Smart Port connectors shall be accessible on the side of the enclosure for connection of room control devices.

4. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.

G. Electrical:

1. The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.

2. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.

3. Where indicated provide one or two independent 0 - 10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.

4. Each dimming output shall have a current sinking capacity of at least 30 mA.

5. The room controller shall be capable of supplying 150 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 Smart Port connectors.

6. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

H. Functional:

1. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.

2. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the Smart Port connectors.

3. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.

4. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.

5. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.

6. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.

7. It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single

zone.

8. Provide the following set up and configuration functions without the need for additional devices or software:

    a. Assign/reassign relays for control by wall switch station buttons
    b. Configure relays for occupancy or vacancy operation
    c. Assign/reassign dimmers to raise/lower switches
    d. Assign dimming channels for response to daylight sensor control
    e. Auto calibrate default daylight sensor sequence of operation
    f. Save preset scenes

9. The NXBTR Bluetooth® radio module and smart phone app from Basis of Design manufacturer or approved equal, shall allow wireless setup and configuration of the room controller and connected devices through a user-supplied smart phone or tablet of any type and with any operating system. The application shall provide as a minimum:

    a. Configure wall switch button types. At a minimum, button types shall include toggle on/off with pilot, preset, on only and off only
    b. Configure up to six zones of daylight harvesting per room with independent set points and time delays
    c. Include or exclude loads from occupancy sensor control
    d. Configure up to 16 load groups per room
    e. Configure up to 16 preset scenes per room with independent fade times
    f. Set independent power up conditions for relays and dimmers
    g. Set independent occupied and unoccupied conditions for each relay and dimmer
    h. Adjust dimmer high and low trim points
    i. Manually control loads allowing use of the phone or tablet as a personal control for the room

    The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Hubbell Building Automation is under license. Other trademarks and trade names are those of their respective owners.

2.3 LOW VOLTAGE SWITCH STATIONS

A. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system smart port.

B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.

C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.

D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.

E. Switch station color shall be white, ivory, light almond, grey, or black as indicated.

F. Switches shall be provided with custom engraving, with final engraving approved by Owner.

2.4 OCCUPANCY SENSORS

A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

B. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.

C. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.

D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.

E. Up to four occupancy sensors may be connected to one room controller.

F. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

G. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.

H. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.

I. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.

a. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

b. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

c. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- (2440-mm-) high ceiling.

d. Provide the following detectors for each specific room type by Basis of Design manufacturer and product specified or approved equal:

1. Storage Rooms, Classrooms, and General Rooms: Provide quantity as indicated on the drawings, Hubbell Building Automation OMNI-DT2000-RP ceiling mounted dual technology sensors with (1) Hubbell UVPP power pack for each sensor.
2. Small Offices and Small Storage Rooms: Provide quantity as indicated on the drawings, Hubbell Building AutomationOMNI-DT500-RP ceiling mounted dual technology sensors with (1) Hubbell UVPP power pack for each sensor.
3. Corridors and Gang Toilet Rooms: Provide quantity as indicated on drawings, Hubbell Building Automation OMNI-US2000-RP ceiling

mounted ultrasonic sensors with (1) Hubbell UVPP power pack for each sensor.

2.5 DAYLIGHT SENSORS

A. The *NX* daylight sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.

B. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.

C. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.

D. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

2.6 EMERGENCY LIGHTING INTERFACE

A. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays, equal to LVS model EPC-1-D, as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer’s representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:

1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.

2. Review the specifications for low voltage control wiring and termination.

3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer’s factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting

controls manufacturer with test results. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.

1. Adjust time delay so that controlled area remains lighted while occupied.

E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)

3. Load Parameters (e.g. blink warning, etc.)

F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activities.

3.3 STARTUP AND PROGRAMMING

A. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.

B. During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.

C. Allow for up to 1 hour of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.4 TECHNICAL SUPPORT

A. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General Conditions and Division-01 Specification sections, apply to work of this section.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY:

A. Extent of panelboard, load-center and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules, and as specified herein.

B. Types of panelboards and enclosures required for the project include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.

D. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-26 sections.

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's data on panelboards and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

1.4 QUALITY ASSURANCE:

A. Installer's Qualifications: A firm with successful installation experience on projects utilizing panelboards similar to those required for this project.

B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards," and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicate that they are suitable for special type of use/application.
4. NEMA Compliance: Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB

1.1,"Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

C. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide panelboard products manufactured by:

1. Square D Co.
2. General Electric Co.
3. Cutler- Hammer / Eaton Electrical
4. Or Approved Equal

2.2 PANELBOARDS:

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

B. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

C. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

E. Feed-Through Lugs: Sized to accommodate feeders indicated.

F. Double-Main Lugs: Sized to accommodate feeders indicated. Provide custom sizes separate from the integral main circuit breakers with internal factory wiring from the double main lugs to the integral main circuit breaker.

G. Special Features: Provide the following features for panelboards as indicated.

1. All Panelboards and distribution boards: Provide both enclosure fronts and doors with full piano type hinges.
2. Integral contactors equal to the ASCO 920 solenoid operated series.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Lighting and Appliance Panelboards General: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

1. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with piano hinge, and doors with piano hinge, flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed. Provide enclosure fronts and doors with full piano type hinges.

C. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

D. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

E. Panelboards shall be made by Square D, type NQ. Panelboards shall be rated minimum 22,000 Ampere R.M.S. Symmetrical for the 120/208V panelboards. Series rated panelboards, equipped with suitable circuit breakers, rated minimum 10,000 Ampere R.M.S. Symmetrical, and protected by the corresponding feeder circuit breaker or fuse located in the Main Distribution Switchboards and\or in the Distribution Panels are acceptable.

F. Special Features: Provide the following features for panelboards as indicated.

1. All Panelboards and distribution boards: Provide both enclosure fronts and doors with full piano type hinges.
2. Digital Meter equal to model #PM2110 EasyLogic power and energy meter.
3. 160kA Surge Protection Device.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARDS:

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

D. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

E. Provide properly wired electrical connections for panelboards within enclosures.

F. Fill out panelboard's circuit directory card upon completion of installation work.

G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space.

3.3 GROUNDING:

A. Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL:

A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.5 ADJUSTING AND CLEANING:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION:

A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles
2. Plugs and Plug Connectors
3. Snap Switches
4. Ground Fault Circuit Interrupter Receptacles
5. Wall Plates

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 26 Section "Electrical Identification" for requirements for labels on wall plates.
2. Division 26 Section “Lighting Controls” for dimmer switch requirements.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

B. NFPA 70 "National Electrical Code".

1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Inc.
2. Leviton.
3. Pass and Seymour Inc.

4. Or Approved Equal

2.2 WIRING DEVICES:

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices except as otherwise indicated. Verify color selections with Architect.

B. Receptacles: Comply with UL 498 and NEMA WD 1. Where not otherwise indicated, provide 20A heavy duty, specification grade receptacles. Provide receptacles equal to Hubbell Wiring Devices HBL5362 series. Verify color selections with Architect.

C. Where receptacles are wired to normal/emergency or emergency only circuits, provide red colored receptacles, with ratings equal to above and below.

D. Tamper-Resistant Receptacles: Provide tamper-resistant 20A receptacles equal to Hubbell Wiring Devices BR20TR.

E. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Provide features indicated.

F. Ground-Fault Interrupter (GFI) Receptacles: Provide weather-resistant, tamper-resistant, "feed-thru" type ground-fault circuit interrupter, with integral commercial heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide receptacles equal to Hubbell Wiring Devices GFTWRST20 series, which comply with 2015 UL 943 for self-testing requirements. Verify color selections with Architect.

G. Interactive Projector recessed receptacle: Provide tamper-resistant receptacle as noted above with single gang recessed electrical box and trim plate. Electrical box shall be Arlington DVFR1W or approved equal.

H. Plugs: 15-amperes, 125-volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4 inch cord hole; match NEMA configuration with power source's.

I. Plug Connectors: 15-amperes, 125-volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4 inch cord hole, match NEMA configuration to mating plug's. Arrange as indicated.

J. Snap Switches: quiet type AC switches as indicated in Table 2 in Part 3 below. Comply with UL 20 and NEMA WD1 and UL94V-2. Where not otherwise indicated, provide 20A industrial/institutional heavy duty grade switches.

1. Standard Toggle: Provide Hubbell Wiring Device-Kellems 122*-I (* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect.
2. Piloted Toggle: Provide Hubbell Wiring Device-Kellems HBL122*PL (* - single pole, three-way and four-way as required) or approved equal with colors as selected by the Architect.
3. Standard Key: Hubbell Wiring Device-Kellems HBL122*LI with HBL1209 key for locking (* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect.

K. Combination Switch and Receptacle: general-duty 3-way quiet switch, 20-amperes, 120-277 volts AC, with toggle switch handle, and 3-wire grounding receptacle, 15-amperes, 120-volts, equip with plaster ears, and with break-off tab feature which allows wiring with separate or common feed, with NEMA configuration 5-15R.

L. Plug-in strips: shall be of prewired, multi-outlet assembly, housed in steel enclosure, as shown on drawings. Outlets shall be of the grounding type as specified for receptacles and spaced and circuited as shown on drawings. Housing shall have a satin gray finish. Plug-in strips shall be Wiremold-Plugmold-series 2000, except otherwise noted on the drawings.

2.3 WIRING DEVICE ACCESSORIES

A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section "Electrical Identification." Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04 inch thick, type 302 satin finished stainless steel.
2. Outdoor covers & material for Wet Locations: Cast Aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations." Provide gray while-in-use cover WP26E by Hubbell Wiring Devices or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

3.2 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Feeder and branch-circuit protection.
2. Motor and equipment disconnecting means.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Current and voltage ratings.
c. Short-circuit current rating.

d. UL listing for series rating of installed devices.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spares: For the following:

a. Potential Transformer Fuses: One for every 10 installed; minimum of 3.
b. Control-Power Fuses: One for every 10 installed; minimum of 3.
c. Fuses and Fusible Devices for Fused Circuit Breakers: One for every 10 installed; minimum of 3.
d. Fuses for Fused Switches: One for every 10 installed; minimum of 3.
e. Fuses for Fused Power-Circuit Devices: One for every 10 installed; minimum of 3.

2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fusible Switches:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Square D Co.
d. Or Approved Equal

2. Molded-Case Circuit Breakers:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Square D Co.
d. Or Approved Equal

3. Combination Circuit Breaker and Ground-Fault Trip:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Square D Co.
d. Or Approved Equal

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

C. Elevators: Provide (2) NO/NC contacts where indicated and for all disconnects in an elevator machine room.

2.3 ENCLOSED 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. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
5. Molded-Case Switch: Molded-case circuit breaker without trip units.
6. Shunt-Trip: Integral shunt-trip module within the Molded-case circuit breaker.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R, lockable.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section “Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. 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.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.

C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 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.

END OF SECTION

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:
   1. Materials.
   2. Finishes.
   3. Luminaire support.

B. Related Requirements:

   1. Refer to Lighting Fixture Schedule on Contract Drawings.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: 5 years from date of Substantial Completion for fixture, as an operating whole. 1 year warranty on the contractor's installation and wiring.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. California Title 24 compliant.

3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.

C. CRI of minimum 80. CCT, as noted in Lighting Fixture Schedule.

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 10 percent of maximum light output in classrooms and common spaces.

F. Internal driver, unless otherwise noted.

G. Nominal Operating Voltage: As noted in Lighting Fixture Schedule.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:

1. [Retain "Acrylic" Subparagraph below if acrylic options in "Diffusers and Globes" Paragraph above are retained.
2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

3. Glass: Annealed crystal glass unless otherwise indicated.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

F. Where installed in drop ceilings, each fixture shall be separately supported by 4 support wires to the concrete structural slab above.

2.5 LIGHTING FIXTURE SCHEDULE

A. General: Various fixture types required are indicated below. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation. In general, where so noted, substitutions for different type of fixture will be acceptable, based only on the alternate manufacturer listed for the specific fixture type, and on objective criteria as submitted in accordance with Instructions to the Bidders.

B. A contractor submitted shop drawing for the lighting fixtures, stamped as Approved by the contractor, constitutes that the contractor has reviewed, coordinated and approved all information (number and quantity of switching devices, ceiling types, wiring schemes, etc.) on the Electrical and Architectural drawings.

C. Refer to the contract drawings for the lighting fixture schedule.

1. Model numbers are shown for information only. The written description for each fixture shall supersede the model number. It shall be the contractor's responsibility to verify all model numbers. All final fixture finishes shall be selected by the Architect prior to fixture approval. Contractor shall bid on the most expensive finish available for each fixture, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:
1. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod, wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 27 15 00
STRUCTURED CABLING SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions of Specifications, apply to this Section.

B. Requirements specified in all other sections of Division 26 & 27, but especially the following sections, apply to this Section.

1. Division 26 Section "Identification for Electrical Systems" for labeling and identification of computer cabling network and equipment.

1.2 SUMMARY

A. The extent of the Building Cabling Network is shown on the drawings and is defined to include (but not by way of limitation), furnishing and installing all equipment, materials, labor and services, related work, and performing all operations necessary to install, inspect, and test the computer and telephone cabling systems in all locations as shown on the drawings and as follows:

1. Building Structured Cabling System shall include all conduit, raceways, innerducts, sleeves, patch panels, equipment racks, j-hooks, supports and backboards whether specifically indicated or not, but required for the complete continuous cabling system that is fully operational based on the Owner's requirements.
2. Provide and install Category 6A, plenum rated, twisted pair cable, with both ends terminated, from patch panel management system in designated wiring closets to wall, floor, or ceiling outlets. Jacket color shall be as selected by the Owner.
3. Provide and install computer/data cabling accessories and devices as herein specified and required for cabling continuity. These items include but not limited to cable terminations, connectors, couplers, hangers, brackets, mounting hardware and frame mountings, tie wraps, bushings, sleeves, fire-stop materials, tools and equipment necessary to complete the installation. System shall be grounded and all terminations shall be made per industry standards.
4. Computer data, telephone and other wiring shall be installed concealed in the walls from the typical jack location double gang backbox through a knockout with fiber bushing to prevent cable damage to above the finished ceiling; on exterior walls provide a conduit to above the finished ceiling with a bushing on the end. Route on J-hooks throughout the building and run at 90 degree angles / follow structure.
5. Provide double gang (duplex) backboxes with single gang faceplates for each of the new data/telephone jack locations, unless otherwise noted on Electrical Cover Sheet drawing.
6. All wiring inside concrete blocks and all exterior walls for jacks and devices located on the block walls shall be installed in minimum 1" conduit from the device box up to above the finished ceiling.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for all cable, components and equipment prior to installation.

B. Cabling Drawings: Submit 1/8" per foot scaled custom layout drawings including cable routing and calculations prepared pursuant to the requirements of the network configuration as listed in this section and shown on the drawings. These drawings, prepared by the cabling system installer must include ALL cable runs, equipment, and associated information for the project. The Owner will review cabling plans with their computer network personnel prior to approval for installation. Include project wiring diagrams showing all connections, cable routes, cable identification, and lengths. Include wiring closet diagrams. Do not exceed IEEE 802.3 Design Guidelines for cable length.

C. Materials List: Submit a complete materials list including part number and quantity for each component.

D. Installer Qualifications: Submit installer’s qualifications as required in 1.4 below.

E. Installation Instructions: Submit manufacturer's printed instructions for each product.

F. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under use conditions.

G. Maintenance Data: Include data in Maintenance Manual specified in General and Supplementary General Conditions of Specifications.

H. Reports: Submit cable and outlet test reports.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firm (material producer) with not less than 5 years of production experience, who’s published literature clearly indicates compliance of products with requirements of this section.

B. Installer's Qualifications: Firms regularly engaged in the installation of computer network wiring and associated products, of types required and who have been installing same for satisfactory use in similar service for not less than 5 years. Installer shall be BICSI certified – submit qualifications for review and approval.

C. Qualifications of Computer Network Cabling Detailer: The Cabling Detailer/Vendor must have a minimum of five years experience in the design and installation of the type of systems as described. The supplier/vendor must maintain a local service organization within a fifty (50) miles radius of the installation and shall maintain spare service replacement parts and accessories to insure minimal down time in the event of an equipment failure.

D. Codes and Standards
   1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable to installation, and construction of computer networks.
      a. NEC Compliance: Comply with NEC requirements as applicable to construction, installation, and color-coding of both power type wires/cables, and

control/signal transmission media.

b. UL Compliance: Comply with applicable requirements of UL Standards 83, 486A and 910. Provide transmission media products which are UL-listed and labeled.

c. ASTM Compliance: comply with applicable requirements of ASTM B1, 2, 3, 8, 33, D-2219, and D-2220. provide copper conductors with conductivity of not less than 98% at 20-deg C (68-deg F).

d. IEEE Compliance: Comply with standard for Gigabit Ethernet.

e. FCC Compliance: Comply with U.S. Federal Communications Commission Class B standard for allowable radiation from network equipment and wiring.

f. FDDI Compliance: Comply with Fiber Distributed Data Interface (FDDI) standards.

g. Manufacturer's Requirements: Comply with the requirements of Owner's Computer Vendor networking design and connections.

h. BICSI & EIA/TIA standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer. Inspect equipment to ensure that no damage has occurred during shipment. Do not install damaged equipment; remove from site and replace damaged equipment with new.

B. Store materials in original packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.

C. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.6 SEQUENCING AND SCHEDULING

A. Sequence installation with other work to minimize possibility of damage and soiling during remainder of construction period. Continuously coordinate work schedules and other details with other trades and Owner’s representative.

1.7 WARRANTY

A. Warrant the Computer Network Cabling and associated equipment and design to be free from inherent mechanical and electrical defects and to operate to design specifications for a period of twenty (20) years from the date of installation and acceptance by the owner. All cables and connectors shall be by a single vendor or vendor’s with an agreement to obtain the required warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal. Source Limitations: Obtain all products except twisted-pair and optical fiber cables through one source from a single manufacturer.

1. Cable:
   a. AMP Incorporated; a Tyco International Ltd. Company.
   b. Belden Inc.; Electronics Division.
   c. Berk-Tec (Basis of Design)
   d. Brand-Rex Co.; Unit of BICC Cables Corp.
   e. General Cable Corporation.
   f. Lucent Technologies; Global Service Provider.
   g. Superior Essex

2. Terminal and Connector Components and Distribution Racks:
   a. Leviton (Basis of Design)

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. All cable installed in supply and return air plenum must be UL listed and approved for installation in supply and return air plenum.

C. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in active workstations.

2.3 MOUNTING ELEMENTS

A. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems".

B. Backboards: 3/4-inch (19-mm), interior-grade, fire-retardant-treated plywood. Paint with 2 coats of UL723 rated intumescent fire retardant latex.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables and Terminations: Listed as complying with Category 6A of TIA/EIA-568-B.

B. Conductors: Solid copper.

C. Data Cabling: Berk-Tec CAT6A, LANmark-10G2 UTP Plenum Rated, or approved equal.
   1. Telephone/Data cabling: Blue.

D. UTP Cable: Comply with TIA/EIA-568-B. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in plenum rated jacket.

E. UTP and STP Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, UTP cable, and STP workstation cable except materials are modified as

required for listing.

F. UTP Cable Connecting Hardware: Comply with TIA/EIA-568-B. IDC type, using modules designed for punch-down caps or tools.

1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC Connecting Hardware: Consistent throughout Project.
3. Data: Leviton Extreme 6A QuickPort Jack, category 6A, vendor#: 6110G-RW6. Color to be White, unless otherwise determined by Owner.

G. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Mounting: Rack.

H. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
2. Mounting: Rack.
3. Ratings: Category 6A.
4. Leviton 48 Port, 110/6Port Panel, CAT6A, Clarity T568A/B, 8POS, 3.5x19, vendor# 6A586-U48.

I. Jacks and Jack Assemblies for UTP Cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service. Provide all new data jacks in the school rated for Category 6A performance.

J. UTP Patch Cords: Four-pair cables in 36-inch lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service.

1. Provide patch cords for each data jack shown on the contract drawings, color to match data/phone, wireless access point, security camara cable color.
2. Provide 72” Orange patch cord for each wireless access point jack and turn over to Owner for wireless access device installation.

K. Workstation Outlets: Jack assemblies mounted in single or multigang faceplate as shown on the drawings.

1. Faceplate: Stainless Steel by Leviton.
    a. Single-Gang: 1-port, 2-port, 3-port, 4-port, 6-port
    b. Dual-Gang: 8-port, 12-port
2. Mounting: Flush, unless otherwise indicated.

L. Telephone Wiring Blocks:

1. Provide wall mountable 110-style wiring blocks for termination of all new telephone cabling.

M. Telephone Backbone cable:

1. Provide Category 3 Backbone Cable, 50-pair, U/UTP, CMP, equal to Beldon DPLN50.

2.5 COMPUTER NETWORK EQUIPMENT:

A. Provide the following computer network system equipment:

1. Provide Category 6A rated modular patch panels with 24 standard ports/jacks per panel; quantities as required for the number of incoming cables into MDF, plus 25% spare capacity.

2. Provide #2 AWG in 1”C building common ground wire to the MDF room from the main electrical switchboard ground.

3. Swing-Out Wall-Mount Rack:

a. Wall mounted, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
1) Swing-out with perforated door, 26RU (49.5” height) Rack: Legrand SWM26RUPD-26-26.

b. UPS: Vertiv GXT5 series, 3000VA (#GXT5-3KL630RT2UXL) or equivalent. Provide UPS with Power Assurance Package.

c. PDU: Vertiv horizontal PDU, (#VP4N32A0).

4. Ground all equipment in the MDF including, but not limited to, equipment racks, wall mounted head-end electronic equipment and the like with #4 AWG..

2.6 CONNECTIONS

A. Ground equipment.

1. Install ground terminal at service location and connect according to Division 26 Section "Grounding and Bonding for Electrical Systems."
2. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

2.7 CABLE SUPPORTS

A. Cable Hooks

1. Provide powder coated cable hooks with riveted assemblies, painted Telecom Gray. Hooks shall have cable retainers. Product shall be equal to Cooper B-Line BCH64-TG.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the computer network cabling system is to be installed, and notify Owner in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Owner and Installer.

3.2 INSTALLATION OF COMPUTER BUILDING CABLING SYSTEM:

A. Install system and components in accordance National Electrical Code, manufacturer's written instructions, with recognized industry practices, and ensure that system complies with requirements and serves intended purpose.

B. Wiring Methods: Install the entire network wiring system in j-hooks, raceways and sleeves.

C. Provide all additional sleeves, conduits and innerducts etc. which are required but not shown on the electrical drawings.

D. Provide bushings on the cut end of all conduits to prevent cable damage.

E. Cables in conduits shall be securely held in place by an industry acceptable practice and installed with sufficient bending radius so as not to kink, shear or damage electrical conductors or optical fibers. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that recommended tensile ratings are not exceeded.

F. Conduit sleeves shall be installed for all wall and floor penetrations, with bushings on each end. Quantity and size of sleeves shall be based on 40% cable fill of sleeve opening.

G. Comply with NECA 1.

H. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps

shall not be used for heating.

10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

I. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

J. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

K. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart with J-hooks.
3. J-hook cable support shall not be filled greater than 50% of the rated capacity to allow for future cabling to be added.
4. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

L. Group connecting hardware for cables into separate logical fields.

M. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, kVA or HP and Larger: A minimum of 48 inches.
1. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

4.1 LABELING

A. All network cables will be labeled at both end and Faceplate jacks following the convention of w-xx-yy:
ww = MDF/IDF Network Closet Number (M, 1, 2, 3,etc.)
xx = Patch Panel Number (01, 05, 11, etc.)
yy = Patch Panel Port Number (1, 2, 3, 4, etc.)

B. Coordinate installation of Patch Panels with Owner prior to installation. All jacks in patch panels will be labelled with printed labels, per the above nomenclature.

4.2 TESTING

A. Certification: Test all network outlets and equipment to the maximum specified performance capability. Provide a report listing each network and telephone outlet location and certify its satisfactory performance in compliance with the specifications.

B. All UTP cabling will be certified to meet and or exceed the Category 6 specifications as set forth in TIA/EIA-568-B.2-1 using field testers. Certifications shall include the following parameters for each pair of each cable installed:

1. Wire map (pin to pin connectivity)
2. Length (in feet)
3. Attenuation
4. Near End Crosstalk (NEXT)
5. Far End Crosstalk (FEXT)
6. ELFEXT
7. Attenuation/Crosstalk Ratio (ACR)
8. Return Loss
9. Propogation Delay
10. Delay Skew

C. All fiber optic cabling shall be tested based on a source/meter setup to report the loss through each fiber strand. Tests shall comply with FOTP-95. Submit written test results to the engineer for review & approval.

D. Test equipment shall provide an electronic and printed record of these tests.

E. Owner reserves the right to hire an independent testing company to spot check the test results. If the results vary more than 10% from the results provided by the Contractor, the Contractor will be required to prove his results are correct or retest the entire system.

4.3 IDENTIFICATION

A. Cable Identification: Identify each cable and termination at both ends with the Owner's room number and the wiring cabinet or device to which connected. Bind all information in a three ring binder. Deliver cable book to owner and obtain receipt.

END OF SECTION 27 15 00

SECTION 28 31 11
DIGITAL ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. Install new fire alarm system at each building, that will be monitored by remote fire alarm system monitoring company via new cellular dialer.

D. In addition to the FACP, the devices that shall be used on this project include, but are not limited to:

1. Addressable pull stations – key operated in select secure areas.
2. Wall mounted adjustable horn/strobes.
3. Wall mounted adjustable strobes.
4. Addressable heat detectors.
5. Addressable monitor and control modules, as required.
6. Remote LCD annunciator.
7. Addressable photoelectric smoke detectors.
8. Addressable remote power supplies, as required.
9. Refer to the contract drawings for additional devices required on the project.

E. The Fire Detection and Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm and detection operations
2. Control and monitoring of elevators, motorized fire doors, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

1.3. QUALIFICATIONS

A. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and certified technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective

signaling systems industry.

D. Fire Alarm System Supplier Certification
NICET Certification: The Fire Alarm System Equipment Supplier shall employ at least one individual full time in the office supporting this project that has attained NICET Level III Certification in Fire Alarm Systems. All submittals and drawings shall be approved, initialed and show the NICET Certification Number of the individual maintaining the certification and taking responsibility for the documentation. All installers in the field shall be NICET Level II certified or the work shall be inspected and certified by a NICET Level III or Level IV individual.

U.L. Certification: The Fire Alarm System Equipment Supplier shall be U.L. listed as an Alarm Service Company for Local, Remote, Auxiliary and Proprietary Protective Signaling Systems. The U.L. Listing Certification number for the Alarm Service Company shall be included in the submittal information.

1.4. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. Division 26: "Electrical Summary of Work."
2. Division 26: "Common Work Results for Electrical."
3. Division 26: "Low Voltage Electrical Power Conductors and Cables."
4. Division 23: "Mechanical Summary of Work "

C. The system and all associated operations shall be in accordance with the following:

1. Guidelines of the following Building Code: BOCA
2. NFPA 72, National Fire Alarm Code
3. NFPA 70, National Electrical Code
4. NFPA 101, Life Safety Code
5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
6. Other applicable NFPA standards
7. Local Jurisdictional Adopted Codes and Standards
8. ADA Accessibility Guidelines

1.5. SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of 100% on-site programming to accommodate system expansion and facilitate changes in operation. All programming shall be capable of being accomplished via the front panel and via a laptop computer. All software operations shall be stored in a non-volatile programmable memory within the FACP. Loss of

primary and secondary power shall not erase the instructions stored in memory.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. Separate alarm, supervisory and trouble logs shall be provided.

D. Wiring/Signal Transmission:

1. Transmission shall be addressable signal transmission, dedicated to fire alarm service only.
2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.
3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.

E. Remote Access:

1. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.
2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.

F. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Supervisory and Trouble events have second-, and third-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
2. Noninterfering: The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and any required remote annunciators, indicating the location and type of device.
5. General Alarm: A system general alarm shall include:
   - i) Indication of alarm condition at the FACP and any required remote annunciator(s).
   - ii) Identification of the device that is the source of the alarm at the FACP and any required remote annunciator(s).
   - iii) Operation of audible and visible notification appliances throughout the building until silenced at FACP. Audible Alarm Notification shall operate Temporal Code.
   - iv) Closing doors normally held open by magnetic door holders.
   - v) Unlocking designated doors.
   - vi) Shutting down supply and return fans serving zone where alarm is initiated.
   - vii) Closing smoke dampers on system serving zone where alarm is initiated.
   - viii) Initiation of smoke control sequence.

ix) Notifying the local fire department.

x) Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified sensors are activated.

6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:

   i) Activate the system supervisory service audible signal and illuminate the LED at the FACP and the remote annunciator.

   ii) Pressing the Supervisory Acknowledge key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.

   iii) Record the event in the FACP historical log.

   iv) Transmission of supervisory signal to remote central station.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.

8. System Reset

   i) The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

   ii) Should an alarm condition continue, the system will remain in an alarmed state.

9. Drill: A manual evacuation (drill) switch shall be provided to initiate an alarm on the FACP.

10. Manual Control: Manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP alphanumeric display.

    i) Manual Bypass Control: The ability to perform a manual bypass of selected automatic functions shall be provided.

    ii) Circuit Enable/Disable Control: The system shall have provisions for disabling and enabling each circuit individually for maintenance or testing purposes.

11. WALKTEST: The system shall have a one person test feature. Enabling the one person test feature at the FACP shall activate the "One Person Testing" mode of the system as follows:

    i) The city circuit connection and suppression release circuits shall be bypassed for the testing group.

    ii) Control relay functions associated to the testing group shall be bypassed.

    iii) The FACP shall indicate a trouble condition.

    iv) The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a code to identify the device.

    v) The control panel shall automatically reset itself after signaling is complete.

    vi) Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

G. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The FACP shall determine the condition of each sensor by comparing the sensor value to the stored values. Device addressing shall not require any special tools or programming devices.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 8 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a Maintenance Terminal CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
5. Peak Value Logging: The FACP shall log the Peak Value of smoke obscuration or degree of temperature for each individual sensor to allow system calibration for maximum response time performance without nuisance alarms based on "actual ambient conditions".
6. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.
7. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

H. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

I. Audible Alarm Notification: By horns in areas as indicated on drawings.

J. Power Requirements

1. The control panel shall receive AC power via a dedicated fused disconnect circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.
4. The incoming power to the system shall be supervised so that any power failure will be

indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.

5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be indicated at the control panel.
6. The system shall support 100% of addressable devices in alarm operated at the same time, under both primary (AC) and secondary (battery) power conditions.
7. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.
8. Power supplies shall be of sufficient capacity to support all the magnetic door hold opens in the facility; provide auxiliary 24V power supplies as required.

1.6. SUBMITTALS

A. General: Submit the following according to Division 01 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
2. Wiring diagrams from manufacturer.
3. Shop drawings showing system details including location of FACP, all devices and circuiting details. All requirements outlined in the NJ Edition of the IBC 2018 shall be provided for the fire alarm system shop drawings. A registered, licensed professional engineering in the State of Pennsylvania shall sign and seal the fire alarm shop drawings.
4. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per all applicable standards.
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of SLC, NAC, RAC, Sensor, and auxiliary control circuits.
6. Operating instructions for FACP.
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
8. Record of field tests of system.

1.7. QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

1.8. EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified

with labels clearly describing contents as follows:

1. Manual Stations: Furnish quantity equal to 10 percent of the number of manual stations installed, but not less than one.
2. Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
3. Smoke Sensors and Heat Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.
4. Sensor Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.
5. Projection Beam Detectors (transmitter and receiver): Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.
6. Monitoring and Control Modules: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than two of each type.

1.9. WARRANTY

A. The Contractor shall provide the Owner with a 1-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Engineer – no exceptions.

B. During the course of the 1-year warranty period, the contractor shall provide a full service contract, including all labor and materials. In addition, the contractor shall provide full NFPA 72 required testing and maintenance services during the 1-year warranty period. NFPA 72 testing and maintenance certified reports shall be submitted to the Owner for record.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight (Basis of Design)
2. Or approved equal.

2.2. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports

shall be adequate to support the required load.

D. All equipment shall be considered non-proprietary and therefore no other manufacturers shall be allowed other than those listed above.

2.3. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP shall be an IntelliKnight Model 6820 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:

i) Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.

ii) Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

Alarm Activate (Drill) Switch: The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

System Reset Switch: Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

Lamp Test: The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of 508 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
4. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.
5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status

LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.

6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
8. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
9. The FACP or each network node shall provide the following features:
    - i) Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
    - ii) Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
    - iii) Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
    - iv) Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
    - v) The ability to display or print system reports.
    - vi) Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
    - vii) PAS presignal, meeting NFPA 72 3-8.3 requirements.
    - viii) Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
    - ix) Periodic detector test, conducted automatically by the software.
    - x) Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
    - xi) Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
    - xii) Walk test, with a check for two detectors set to same address.
    - xiii) Control-by-time for non-fire operations, with holiday schedules.
    - xiv) Day/night automatic adjustment of detector sensitivity.
    - xv) Device blink control for sleeping areas.
10. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits

(NAC 1,2,3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

D. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in incompliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The system shall support an 80 character display. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD).
2. The display shall provide all the controls and indicators used by the system operator:
   i) The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
4. The display shall also provide Light-Emitting Diodes.
   i) The 80-character display shall provide 12 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.
5. The system shall support the display of battery charging current and voltage on the 80-

character LCD display.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support one SLC. Each SLC interface shall provide power to and communicate with up to 127 intelligent detectors (ionization, photoelectric or thermal) and intelligent modules (monitor or control). SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
   - i) One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.
   - ii) One EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL-Listed are not considered acceptable substitutes.
   - iii) One EIA-232 interface shall be used to connect a UL-listed CRT terminal. This interface shall include special protocol methods that allow off-site monitoring of the FACP over standard dial-up phone lines. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset, or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
   - iv) The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
   - v) The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

H. DACT (Digital Alarm Communicator Transmitter):

1. Cellular dialer shall be equal to Telguard model TG-7FS, or approved equal. Coordinate with Owner prior to purchase whether AT&T or Verizon service is preferred.

I. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

J. Power Supply:

1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:

   Ground Fault LED

   AC Power Fail LED

   NAC on LED (4)
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

K. Auxiliary Field Power Supply - Addressable

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
2. The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional .5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.
3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.
4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at approximately 3.33k baud.
7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event

of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.
9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.
10. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
11. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
12. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
13. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.
14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

L. Field Charging Power Supply (FCPS): The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
5. The FCPS include power limited circuitry, per 1995 UL standards.

M. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be

independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
   - i) Device status
   - ii) Device type
   - iii) Custom device label
   - iv) View analog detector values
   - v) Device zone assignments
   - vi) All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
    - i) Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
    - ii) Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.

iii) All devices tested in walk test shall be recorded in the history buffer.

11. Waterflow Operation: An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
12. Supervisory Operation: An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. Signal Silence Operation: The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.
14. Non-Alarm Input Operation: Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.
15. Combo Zone: A special type code shall be available to allow waterflow and supervisory devices to share a common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

2.4. SYSTEM COMPONENTS:

A. Programmable Electronic Sounders - Gentex Commander Series

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
3. Shall be wall or ceiling mounted as shown on plans.
4. Shall be flush or surface mounted as shown on plans.

B. Programmable Electronic Strobe and Horn/Strobes – Gentex Commander Series

C. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. Manufacturer shall be responsible to determine the candela value for each strobe shown on the contract drawings based on the size of the room and the height of the ceilings. Adjustable strobes are preferred. All shop drawings shall reflect the final candela selection.
2. The maximum pulse duration shall be 2/10 of one second.
3. Strobe intensity shall meet the requirements of UL 1971.
4. The flash rate shall meet the requirements of UL 1971.
5. Shall be wall or ceiling mounted as shown on plans.
6. Shall be flush or surface mounted as shown on plans.

D. Manual Fire Alarm Stations

1. Manual fire alarm stations shall be non-code, non-breakglass type, institutional rated housing/device that requires that a special key be used to release the actuation door before it can be operated.
2. Stations must be designed such that after an actual activation, they cannot be restored to

normal except by key reset.

3. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 100 feet (30.5 m) front or side.
4. Manual stations shall be constructed of high impact Lexan or Aluminum, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters one half inch (12.7 mm) in size or larger.
5. Each manual pull station shall be supplied with an addressable monitoring module so each pull station is uniquely identifiable. If Institutional manual pull stations are available in an addressable configuration, then the monitoring modules are not required.

E. Duct Smoke Detectors: Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes.

F. Waterflow Indicator:

1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
3. All waterflow switches shall come from a single manufacturer and series.
4. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
5. Where possible, locate waterflow switches a minimum of one (1) foot from a fitting which changes the direction of the flow and a minimum of three (3) feet from a valve.

G. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.
    i) This unit shall provide for each zone: alarm indications, using a red alarm an yellow trouble long-life LEDs and control switches for the control of fire alarm control panel functions. The annunciator will also have an ON-LINE LED, local piezo electric signal, local acknowledge/lamp test switch, and custom slide-in zone/function identification labels.

ii) Switches shall be available for remote annunciation and control of output points in the system, system acknowledge, telephone zone select, speaker select, global signal silence, and global system reset within the confines of all applicable standards.

H. Alphanumeric LCD Type Annunciator – Model 5860R:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 8 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

I. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

J. Field Wiring Terminal Blocks: For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall

be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
13. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

B. Addressable Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

C. Addressable Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius). It shall connect via two wires to the fire alarm control panel signaling line circuit.

D. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
2. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

E. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be

provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

F. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

G. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.6. INTELLIGENT POWER MODULE – 5895XL

A. General: Components include battery, charger, and an automatic transfer switch.

B. Module shall provide 5.0 amps of output power, six Flexput I/O circuits, and two Form C relay circuits.

C. Battery: Sealed lead-acid type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all notification appliances in alarm or supervisory mode for a period of 5 minutes.

2.7. MISCELLANEOUS MONITORING AND CONTROL

A. Provide addressable monitoring control module and wiring to HVAC unit over 2,000 cfm. The modules shall provide a contact closure in the event of an alarm condition, which will cause the all HVAC systems to shut-down based on the alarm condition of one of the smoke detectors in the full automatic coverage building. Contractor is required to contract with controls manufacturer/installer to provide the contact interface and programming for each of the HVAC units.

B. Provide addressable control modules to release all magnetically locked egress doors.

C. Provide 24V fire alarm and/or auxiliary power supplies for powering and releasing all magnetic door hold opens in the building.

PART 3 – EXECUTION

3.1. INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be NICET Level II certified or the work shall be inspected and certified by a NICET Level III or Level IV individual.

3.2. EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

B. System Retrofits shall require that Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

3.3. WIRING INSTALLATION

A. System Wiring: Wire and cable shall be MC cable type FPLP and shall be acceptable to the Authority Having Jurisdiction (AHJ and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC). Refer to Division 26 Section “Low Voltage Power Conductors and Cables” for acceptable locations for type MC cable vs. individual conductors in raceway.

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable sizes and types (shielded and non-shielded) to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Paint fire alarm system junction boxes and covers red.

3.4. FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of

fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.

H. Final Test, Certificate of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

3.5. CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.6. TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours' training.
2. Schedule training with the Owner at least seven days in advance.

END OF SECTION